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U.S. Environmental Protection Agency And U. S. Army Corps of Engineers Kansas City District

Final Interim Remedial Action Report

Rockaway Borough Superfund Site
East Main/Wall Street Plume – OU2

Rockaway Borough, New Jersey

August 2012

CAPE

CDM Smith

Final Interim Remedial Action Report

Record of Preparation, Review, and Approval

Rockaway Borough Superfund Site, East Main/Wall Street Plume – OU2

Rockaway Borough, New Jersey

This Report has been prepared in accordance with EPA's *Close Out Procedures for National Priorities List Sites*, EPA 540-R-98-016, OSWER Directive OSWER 9320.2-09A, dated January 2000, and the Addendum to Policy for Close Out Procedures for NPL Sites, OSWER Directive 9320.2-13, dated December 2005, and serves to document that the remedies discussed herein have been constructed in accordance with the September 30, 1991 Record of Decision and all EPA approved plans and specifications prepared thereunder.

RA Report Prepared by:	RA Contractor Certifying Engineer:	Signature Dora Britt P.G. Name/Title Project Manager Date 8/15/12
Approved By:	EPA Region 2 Approving Official:	Signature ________ Name/Title ________ Date ________

Table of Contents

Tables

Figures

Appendices

Acronyms

ACI	American Concrete Institute
ACM	asbestos containing material
AISC	American Institute of Steel Construction
Alimi	Alimi Builders, Inc.
amsl	above mean sea level
ARAR	Applicable or Relevant and Appropriate Requirements
ASCE	American Society of Civil Engineers
ASTM	American Society of Testing and Materials
ATK	Alliant Techsystems
BAI	Bigler Associates, Inc.
bgs	below ground surface
CAPE	CAPE Environmental Management, Inc.
CCRs	Contractor Change Requests
CDM Smith	CDM Federal Programs Corporation
cfm	cubic foot per minute
CFR	Code of Federal Regulations
cis-1,1-DCE	cis-1,1-dichloroethene
CMU	concrete masonry unit
CQCSM	Contractor Quality Control Systems Manager
CQC	Contractor Quality Control
CQCP	Contractor Quality Control Plan
CRA	Conestoga-Rovers & Associates
CTI	CTI and Associates, Inc.
CVOC	chlorinated volatile organic compound
CY	cubic yard
d_{50}	median diameter (grain size)
1,1-DCE	1,1-dichloroethene
DGA	dense graded aggregate
DNAPL	dense non-aqueous phase liquid
DOT	Department of Transportation
DPW	Department of Public Works
DR	dimension ratio
DSW	discharge to surface water
EM/WS	East Main/Wall Street
EPA	United States Environmental Protection Agency
eV	electron volt
F	Fahrenheit
FCR	Field Change Request
FEMA	Federal Emergency Management Agency

FHA	Flood Hazard Area
ft	foot
fps	foot per second
FRP	fiberglass-reinforced plastic
GAC	granular activated carbon
GAP	Green Acres Program
gpd	gallon per day
gpm	gallon per minute
GTTI	Groundwater Treatment Technologies, Inc.
GWTF	groundwater treatment facility
HAP	Hazardous Air Pollutant
HDR/OBG	HDR/O'Brien & Gere Joint Venture
HDPE	high density polyethylene
HMI	human machine interface
HP	horsepower
H&S	health and safety
HVAC	heating, ventilation, and air conditioning
IBC	International Building Code
I/O	input/output
ITP	Initial Testing Program
JCP&L	Jersey Central Power and Light
K&K	Klockner and Klockner
KVA	kilovolt-ampere
kW	kilowatt
kWH	kilowatt hour
lb	pound
LBP	lead-based paint
LEL	lower explosive limit
LF	linear feet
LTRA	Long-term Response Action
MCL	Maximum Contaminant Level
MDWP	Municipal Drinking Water Plant
MEK	methyl ethyl ketone
MOA	Memorandum of Agreement
NAD	North American Datum
NEC	National Electric Code
NGVD	National Geodetic Vertical Datum
N.J.A.C.	New Jersey Administrative Code
NJDEP	New Jersey Department of Environmental Protection
NJPDES	New Jersey Pollutant Discharge Elimination System

NPL	National Priorities List
NTP	Notice to Proceed
OIT	operator interface terminal
O&M	operation and maintenance
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
PCE	tetrachloroethene
PDI	pre-design investigation
PID	photoionization detector
P&ID	process and instrumentation diagram
PLC	programmable logic controller
ppb	part per billion
PPE	personal protective equipment
ppm	parts per million
PRAC	Pre-Placed Remedial Action Contract
PRP	potentially responsible party
psi	pound per square inch
PVC	polyvinyl chloride
PVDF	polyvinylidene difluoride
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
RA	Remedial Action
RD	Remedial Design
RFP	Request for Proposal
RI	Remedial Investigation
RIO	remote input/output
ROD	Record of Decision
ROSI	Recreational and Open Space Inventory
rpm	revolutions per minute
SBS	styrene butadiene styrene
SCADA	supervisory control and data acquisition
SERAS	Lockheed Martin Scientific, Engineering, Response & Analytical Services
SESC	Soil Erosion and Sediment Control
SS	stainless steel
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
TCE	trichloroethene
TCL	Target Compound List
THF	tetrahydrofuran

TOC	total organic carbon
TRC	Technical Review Committee
µg/L	microgram per liter
UPS	uninterruptible power supply
USACE	United States Army Corps of Engineers
USDA SCS	United States Department of Agriculture Soil Conservation Service
UV	ultra-violet
V	volt
VAC	voltage in alternating current
VFD	variable frequency drive
VOC	volatile organic compound
VTP	vertical turbine pump
wc	water column

Section 1
Introduction

The objective of this Final Interim Remedial Action (RA) report is to document the RA activities performed to achieve the requirements set forth in the United States Environmental Protection Agency's (EPA) September 1991 Operable Unit (OU) 2 Record of Decision (ROD) (EPA 1991) for the Rockaway Borough Well Field Superfund Site, East Main/Wall St. Plume (the Site) located in the Borough of Rockaway, Morris County, New Jersey. The OU2 ROD addresses the groundwater contamination in the Borough. This report was prepared by CAPE Environmental Management, Inc. (CAPE). Per the direction of EPA Region 2/US Army Corps of Engineers (USACE) Kansas City District management, the report was prepared in accordance with the EPA's Close Out Procedures for National Priorities List Sites (NPL), EPA 540-R-98-016, Office of Solid Waste and Emergency Response (OSWER) Directive 9320.2-09A-P, dated January 2000 (EPA 2000) and the Addendum to Policy for Close Out Procedures for NPL Sites, OSWER Directive 9320.2-13, dated December 2005 (EPA 2005).

USACE Kansas City provided technical support to EPA during the Rockaway RA. In support of these efforts, USACE contracted with CAPE to perform the remedial construction in accordance with the design documents. The work was performed under Pre-Placed Remedial Action Contract (PRAC) No. W912DQ-05-D-0001, Task Order 0005. USACE New York district provided quality assurance (QA) oversight through the use of onsite personnel to monitor project performance.

CDM Federal Programs Corporation (CDM Smith), a subcontractor to CAPE, was the design engineer of record and reviewed and approved all technical submittals.

1.1 Purpose and Organization of Report

The purpose of this Interim RA Report is to document the RA construction activities performed including final design, permitting, and construction of the groundwater pump and treat system. This report includes the following information:

- **Section 1 - Introduction** – This section includes a description of the site environmental setting and historical operations.
- **Section 2 - Operable Unit Background** – This section summarizes the ROD requirements, site contamination, and components of the remedial design (RD).
- **Section 3 – Remedial Construction Activities** – This section summarizes the scope and sequence of activities undertaken to construct and implement the RA.

- **Section 4 - Chronology of Events** – This section provides a tabular summary of significant project events.
- **Section 5 - Performance Standards and Construction Quality Assurance/Quality Control –** This section discusses the construction and sampling quality assurance (QA)/quality control (QC) implemented during the RA.
- **Section 6 - Inspections and Certification** – This section summarizes the final inspection, Initial Testing Program (ITP) startup activities, and health and safety (H&S) procedures.
- **Section 7 - Operation and Maintenance** – This section describes the post-construction operation and maintenance (O&M) activities, including routine O&M, monitoring and reporting.
- **Section 8 - Summary of Project Costs** – This section provides a summary of the actual RA project costs.
- **Section 9 - Observations and Lessons Learned** – This section provides a description of observations and lessons learned, highlighting successes and how encountered problems were resolved.
- **Section 10 - Contact Information** – This section provides the contact information for the site.
- **Section 11 - References** – This section provides the references used in development of this RA report.

1.2 Site Location and Description

The Site covers a 2-square mile area and includes three municipal water supply wells, which are located in a glacial aquifer designated by EPA as the sole source aquifer for Rockaway Borough and the surrounding communities. The site location is shown on Figure 1-1. In 1980, volatile organic compounds (VOCs) were detected in the municipal wells. The contaminated wells are close to the Rockaway River, which runs through the Borough. The Site is located in a suburban residential setting and is surrounded by homes, businesses, and municipal property. The Borough of Rockaway's municipal wells supply potable water to about 11,000 people.

Although 13 VOCs have been detected in the well water, trichloroethene (TCE) and tetrachloroethene (PCE) are the primary contaminants of concern. Well water is treated to drinking water standards before being supplied to the residents of Rockaway Borough. The Site is being addressed in 4 stages:

- OU 1 - Initial actions, including O&M of liquid-phase granular activated carbon (GAC) treatment of municipal wells
- OU 2 - Long-term remedial actions focusing on the cleanup of groundwater and the sources of the contamination
- OU 3 – Source area remediation Klockner & Klockner (K&K) plume
- OU 4 – Source area remediation East Main/Wall Street (EM/WS) plume

1.3 Site History

In 1980, VOC contamination was discovered in the municipal water supply, and a GAC treatment system was installed. In 1993, an air stripping system was added in advance of the carbon treatment system to improve system operation and reduce operating costs.

Extensive soil and groundwater studies were conducted within Rockaway Borough by the New Jersey Department of Environmental Protection (NJDEP) and the EPA. These studies led to a 1986 ROD for continued O&M of the Rockaway Borough water treatment system (OU1). A second ROD was issued in 1991, which called for groundwater extraction of plumes emanating from the K&K and the EM/WS areas (OU2).

In 1994, EPA and Thiokol entered into a Consent Decree whereby Thiokol agreed to, among other things, conduct the RD for the Rockaway Borough Well Field Site. In the RD, Thiokol was required to address both the PCE plume emanating from the EM/WS area and the TCE plume emanating from the K&K site, but only to remediate the K&K plume via a groundwater remedy. Thiokol was not required to implement the RA for the PCE plume or for any sources of contamination throughout the Borough, emanating from the EM/WS area.

In 2001, Alliant Techsystems (ATK) purchased Thiokol and assumed responsibilities for implementing the RA.

In December 2002, an Intermediate (65%) Design Report was prepared and submitted for the EM/WS Plume. In November 2004, the Borough of Rockaway passed a resolution that authorized the Borough of Rockaway to enter into an access agreement with EPA to construct the EM/WS treatment building in Rockaway River Park along Jackson Avenue.

On July 12, 2005, a technical meeting was held between EPA, USACE, and their subcontractors along with Conestoga-Rovers & Associates (CRA, the design engineer for ATK) to discuss the changes to the EM/WS RD with respect to the location of the EM/WS Plume treatment building and the alignment of the new force main route. In August 2005, a Revised Intermediate (65%) Design Report was subsequently submitted that presented updated drawings and specifications to reflect the changes. On September 28, 2005, CRA, on behalf of ATK, submitted the Pre-Final (95%) Design Report to EPA, which included updated drawings and specifications, along with an updated cost estimate, and the Final (100%) Design Report was submitted in February 2006.

CAPE was subsequently tasked with the RA, through its PRAC W912DQ-05-D-0001, Task Order 0005. The RA activities performed by CAPE are the subject of this report as described in later sections.

1.4 USACE and EPA Project Management

USACE Kansas City District was responsible for the RD and USACE New York District was responsible for construction activities. USACE New York District provided full-time, on-site technical representatives throughout the duration of the project. USACE representatives were responsible for assuring the project was executed in accordance with design documents and approved site-specific plans. USACE on-site representatives maintained a direct line of communication with CAPE's project management team and the EPA Region 2 Remedial Project Manager. Weekly project/progress meetings were held at the site throughout the duration of the field activities.

Key project personnel included:

- Brian Quinn, EPA Region 2 – Remedial Project Manager
- Saqib Khan, USACE Kansas City District – Project Manager
- Gene Urbanik, USACE New York District – New Jersey Area Engineer
- Neal Kolb, USACE New York District – Resident Engineer
- Michael Johnson, USACE New York District – Team Leader
- Kevin O'Brien, USACE New York District – Project Engineer
- Kam Chan, USACE New York District – Project Engineer
- Ronny Hwee, USACE New York District – Project Engineer

Section 2
Operable Unit Background

2.1 OU2 Requirements

In 1980, contamination by VOCs was discovered in the municipal water supply and a GAC treatment system was installed. An air stripping system was later added in advance of the carbon treatment system to improve system operation and reduce operating costs. Extensive soil and groundwater studies were conducted within Rockaway Borough by NJDEP and the EPA. These studies led to the 1986 ROD for OU1 for continued O&M of the Rockaway Borough water treatment system. A second ROD was issued September 30, 1991 for OU2, which called for groundwater extraction of plumes emanating from the K&K and the EM/WS areas. Specifically, the remedy includes the following elements:

- Extraction of contaminated groundwater and restoration of the groundwater to drinking water standards, or the more stringent of federal or state Maximum Contaminant Levels (MCLs);
- Treatment of the extracted VOC contaminated groundwater via air stripping;
- Discharge of treated groundwater to the aquifer or surface water in accordance with the applicable discharge standards; and
- Appropriate environmental monitoring to ensure the effectiveness of the remedy.

The remediation goals for the groundwater contaminants of concern at the site are included in **Table 2-1**.

In 1994, EPA and Thiokol entered into a Consent Decree whereby Thiokol agreed to, among other things, conduct the RD for the Rockaway Borough Well Field Site. In the RD, Thiokol was required to address both the PCE plume emanating from the EM/WS area and the TCE plume emanating from the K&K site, but only to remediate the K&K plume via a groundwater remedy. Thiokol was not required to implement the RA for the PCE plume or for any sources of contamination throughout the Borough, emanating from the EM/WS area. In 2001, ATK purchased Thiokol and assumed responsibilities for implementing the RA.

2.2 Site Topography

The Borough of Rockaway is located in the easternmost portion of the New Jersey Highlands physiographic region in Morris County, New Jersey. The Highlands consist of rolling hills rising to elevations between 550 and 900 feet. The Rockaway River flows east through the central portion of the Borough. The EM/WS area includes an 8-block area located in the north central portion of the Borough containing 62 properties adjacent to portions of East New Street, East Main Street, West Main Street, Jackson Avenue, Mott Place, Maple Avenue, Dock Street, and Wall Street. Many surviving urban landscape features reflect Rockaway's industrial heritage such as Morris Canal Plane No. 6 East, the former Morris Canal, portions of canal walls, and dams in the Rockaway River. The Borough of Rockaway was settled during the 1700s in conjunction with agriculture and iron mining, and developed into an industrial and residential center during the 1800s. Historically, the Morris Canal operated between 1826 and 1924, connecting coal mining areas of Pennsylvania to markets in New York, and crossing New Jersey iron mining and manufacturing centers including the Borough of Rockaway. The Morris Canal crossed the EM/WS area in the vicinity of the municipal parking area west of Wall Street, and beneath Dock Street and Heady Field east of Wall Street (see **Figure 2-1**). Features associated with the Morris Canal included the former canal prism, Upper Basin at Plane No. 6 East, the former towpath, a stone culvert, stone walls, and other architectural features. Many existing dwellings and commercial buildings in the EM/WS area were constructed during the canal period.

2.3 Site Geology

2.3.1 Regional Geology

This section discusses the regional geology of the area. Site-specific geology is discussed in Section 2.3.2. The following discussion is taken from the Final Pre-Design Investigation Report (HDR/OBG, 2010), which is based on the various reports which are cited herein. The Borough of Rockaway is located within the New Jersey Highlands section of the New England physiographic province, also known as the Reading Prong through New York, New Jersey, and Pennsylvania. The Highlands are a 15- to 20-mile wide band which trends northeastward, as do its topographic ridges and valleys and geologic formations (TetraTech, 2005; Drake et al, 1996).

The Highlands were formed during the middle Proterozoic Era (late Pre-Cambrian) during the Ottawan Orogeny of the late Grenvillian orogenic series (about one billion years ago). The Grenville Orogenies were high-deformation, mountain-building episodes during which tectonically-derived magmas emerged through the shallow sea floor (TetraTech, 2005; Gates et al, 2003). A long, narrow band of valleys and ridges running through the center of the Highlands is comprised of Paleozoic Era sedimentary rocks. This band, a graben, is the result of downfaulted block.

During the ice age, which began 2 to 3 million years ago, New Jersey underwent at least three glaciations. During the last glaciation, known as the Wisconsinian Glaciation, continental ice sheets covered most of northern New Jersey. The ice sheet began to melt rapidly about 15,000 years ago. In New Jersey, the furthest advance of the ice sheet terminated in central Morris County and is marked by a poorly sorted mixture of sand, clay, and boulders called the terminal moraine. The terminal moraine and glacial lakes resulted from ice damming and glacial runoff, which occurred 8,000 to 15,000 years ago (TetraTech, 2005; Gill and Vecchioli, 1965). Glacial deposits and fill material overlie bedrock throughout most of the region. The thickness of these deposits varies and is typically thickest in the bedrock troughs. In addition, the thickness of these deposits varies depending on the proximity to the terminal moraine, which generally parallels the Rockaway River. In the Borough of Rockaway, glacial deposits may vary in thickness from nonexistent (in bedrock outcrop areas) to over 200 feet thick in valley bottoms. Geologic investigations performed in the region by EPA (TetraTech, 2005; ICF, 1991) determined that these glaciofluvial deposits range in elevation from 565 feet to approximately 400 feet mean sea level (msl) near the center of the existing valley.

The glacial deposits are comprised of sand, gravel, lacustrine silt and clay, and till (generally tight gravel, sand, silt, and clay mix). In general, these deposits are classified as terminal moraine, ground moraine, and stratified drift. The moraine material generally consists of till deposits. Stratified drift includes lacustrine deposits of fine-grained sands and silts (glacial lakes and ponds) and glaciofluvial deposits (i.e., gravels and sands in outwash plains south of the terminal moraine and low terraces and buried valleys north of the moraine). Glaciofluvial and Wisconsinian age terminal moraine deposits are present in the Borough.

According to the Surficial Geologic Map of the Dover Quadrangle, New Jersey, by Scott D. Stanford (1989), the 2 Wall Street area is classified as Qlwtm for Till of the Terminal Moraine. As described, this area consists of glacial Lake Dover deposits from the Lake Wisconsian, which consisted of lake-bottom and deltaic fine sand and silt and deltaic sand and gravel deposited in glacial Lake Dover.

Specifically, the Till of the Terminal Moraine is described as yellowish-brown to grayish brown till that forms the ridge and kettle topography of the terminal moraine and is up to 150 feet thick on uplands and up to 100 feet thick in filled valleys. The till material generally overlies and can be interbedded with stratified sediment deposits of nearby glacial lakes formed south of the terminal moraine. Glacial deposits generally contain cobbles and boulders in near surface moraine and outwash units, but below these units, glacial lake deposits predominate. The lacustrine deposits are composed primarily of sand in near shore areas of the former lakes and of silt in lake-bottom deposits.

Bedrock within the area consists primarily of early Pre-Cambrian metamorphic (crystalline) rocks including interlayered hornblende, granite, alaskite, quartz-feldspar gneiss, biotite gneiss, pyroxene syenite, quartz diorite, and minor amphibolite and granite pegmatite (TetraTech, 2005; ICF, 1991). Moving across strike from southeast to northwest through the Borough of Rockaway, rock type varies from diorite to gneiss to granite to hornblende-granite (TetraTech, 2005; Drake et al, 1996). Paleozoic sedimentary rocks occur in a 3- to 4-mile wide band several miles west of the Borough. They include quartzite, conglomerate, purple and red shale, dolomite, gray siltstone of Cambrian to Silurian Age, and gray siltstone, shale, and sandstone of Devonian Period (TetraTech, 2005; ICF, 1991).

2.3.2 Site-Specific Geology

The following discussion is based on geologic information obtained from shallow and deep soil borings installed across the Site during the RI and confirmed/updated as part of the pre-design investigation (PDI). Fill composed primarily of sand, gravel, cobbles, and boulders, with slag, cinders, coal, ash, metal, glass, brick, and shells range from approximately 2 to 12 feet below ground surface (bgs). Urban fill materials encountered are consistent with industry that would have been located along the canal, particularly the foundry that formerly occupied parcels south of the canal along modern day Maple Avenue. The encountered fill is typically dry to moist.

Native soils consisting of brown sand with varying amounts of gravel, silt, cobbles, and boulders exist from the bottom of the fill down to bedrock. Typically, clay and silt comprise approximately 15 percent or less of the soil and gravel comprise approximately 5 to 35 percent of the soil. Groundwater depth, as measured during the PDI, ranges from approximately 5 to 68 feet bgs and is dependent on location and total depth of the wells. Depth to bedrock varies based on topography and consists of approximately 2 feet of weathered saprolite overlying the bedrock interface. During the installation of MW-1D (near extraction well EW-5), bedrock was encountered at approximately 178 feet bgs while at MW-3D (near Halsey Avenue) it was found at approximately 168 feet bgs. During the drilling of MW-2D (in the park), the maximum depth drilled was down to approximately 200 feet bgs with no bedrock encountered.

A geologic cross-section of the site is shown on **Figure 2-2**.

2.4 Site Hydrogeology

2.4.1 Regional Hydrogeology

This section discusses the regional hydrogeology of the area. Site-specific hydrogeology is discussed in Section 2.4.2. The following discussion is taken from the Final Pre-Design Investigation Report (HDR/OBG, 2010), which is based on the various reports which are cited herein. The Morris County area is underlain by two aquifers or water-bearing units, whereby groundwater is transmitted through intergranular pore spaces in unconsolidated materials or through fractures in underlying bedrock. Of the unconsolidated deposits, the glaciofluvial deposits are a major water supply for municipalities (e.g., Borough of Rockaway). The bedrock fractures are primarily a source for local domestic supplies and in some cases municipal supplies. According to the various OU RODs for the Site, the Borough of Rockaway is underlain by a sole-source aquifer; therefore, it has been assumed that the glaciofluvial and bedrock aquifers are hydraulically connected and can be considered one aquifer.

Glaciofluvial aquifers provide the predominant groundwater supply to the region. Recharge to the glaciofluvial aquifers occurs in the form of precipitation, infiltration through glaciofluvial deposits, and runoff from bedrock ridges to the upland outcrop areas of the glacial sediments. The highest yielding zones, in which municipal wells are screened, tend to occur in the more gravelly channels in the deeper portion of the deposits (TetraTech, 2005; ICF, 1991).

Of 127 public supply wells completed in glaciofluvial deposits, yields ranged from 20 to 2,200 gallons per minute (gpm), averaging 502 gpm (TetraTech, 2005; Gill and Vecchioli, 1965). The transmissivity of these aquifers averaged high (i.e., 135,000 gallons per day/feet [gpd/ft]), based on 13 pumping tests in Morris County, primarily in the Chatham, Florham Park, Morris Plains, and Wharton areas. An average storage coefficient of 3.9 x 10E-4 indicates semi-confined to confined conditions, likely resulting from overlying finer deposits of the terminal moraine and other finer grained units (TetraTech, 2005; Gill and Vecchioli, 1965). The glaciofluvial aquifer is unconfined throughout most of the area (TetraTech, 2005; ICF, 1991).

The high-yielding glaciofluvial aquifer has been developed as a source of potable water by both the Borough of Rockaway and Rockaway Township. In the 1960s, the Borough consumed approximately 780,000 gpd from glaciofluvial deposits (TetraTech, 2005; Gill and Vecchioli, 1965). More recent data from the Borough wells shows usage of 1,250,000 gpd in January 2004 (640,000 gpd, 290,000 gpd and 320,000 gpd, respectively, from municipal wells No. 6, No. 5, and No. 1). A higher summer usage example in July 2003 shows an average total of 1,370,000 gpd (760,000 gpd, 300,000 gpd and 310,000 gpd, respectively, from municipal wells No. 6, No. 5, and No. 1). These wells are all screened in glaciofluvial deposits (TetraTech, 2005; Rossi, 2004).

The bedrock aquifer in the region is predominantly the fractured metamorphic rocks underlying the glacial deposits. Groundwater yield occurs through the fractures that intersect the wells completed in the bedrock. The northeast-trending faults and fracture sets tend to generate the greatest groundwater flow, as shown by elliptical southwest-northeast trending cones of depression that result from pumping bedrock wells in this region.

Based on a Morris County groundwater supply study (TetraTech, 2005; Gill and Vecchioli, 1965), 79 large-diameter wells completed in the crystalline bedrock formations yielded between 4 and 400 gpm, averaging between 50 and 75 gpm. Suitable yields generally occur at depths shallower than 300 feet (TetraTech, 2005; Gill and Vecchioli, 1965). Transmissivities are estimated at 2,000 to 3,000 gpd/ft (i.e., fairly low for municipal wells in these formations with storage coefficients of 0.001 that would indicate semi-confined conditions). In the 1960s, the Borough of Rockaway consumed approximately 130,000 gpd from wells completed in fractured metamorphic bedrock (TetraTech, 2005; Gill and Vecchioli, 1965). Today their supply is entirely from glaciofluvial deposits (TetraTech, 2005; Rossi, 2004). This hydrogeologic investigation from which this information is derived was performed during the Final Pre-Design Investigation Report (HDR/OBG, 2010).

2.4.2 Site-Specific Hydrogeology

The following discussion is taken from the Final Pre-Design Investigation Report (HDR/OBG, 2010), which is based on the various reports which are cited herein. Groundwater flow in the Borough of Rockaway is generally from the uplands toward the Rockaway River (i.e., a general east-southeastward direction). However, with pumping of municipal wells No. 6/6B, No. 5, and/or No. 1, groundwater flow is reversed from the river toward the pumping wells. This reversal induces inflow from the river through the aquifer toward the wells (TetraTech, 2005; ICF, 1991). Depth to groundwater, as measured during the PDI, ranges from approximately 5 to 68 feet bgs and is dependent on location and total depth of the well. The depth to water in paired or clustered wells at the same locations are different due to a difference in hydraulic head resulting from the vertical hydraulic gradient.

The conceptual model for this Site includes two aquifers, the overburden and lower bedrock aquifer. The overburden aquifer exhibits the characteristics of a water table aquifer and, in certain areas, may exhibit semi-confined conditions. Drilling has not indicated the presence of a continuous confining layer across the area that prevents downward migration of contaminants.

The overburden aquifer is heavily pumped for water supply purposes and three high capacity wells in the area are likely pumped at a rate that exceeds local recharge. Historical well logs for GW-5 indicate that, when this well was drilled, it flowed at the surface indicating confined conditions. It is suspected that long-term water level declines from heavy pumping have essentially negated any confinement. A significant portion of the pumpage is now likely induced infiltration from nearby surface water including the Rockaway River.

2.5 Summary of Groundwater Contamination

The Site CVOC groundwater plumes cover a 2-square mile area, on which are located three municipal water wells that supply water to nearly 11,000 people. The source of the EM/WS groundwater plume appears to be a local dry cleaning establishment that discharged dry cleaning chemicals to the sub-surface. Studies completed as part of OU4 have identified a source in both the soils and groundwater that is of sufficient strength to account for the existing groundwater concentrations downgradient of the source area. There are two main aquifers encountered at the Site, the overburden and lower bedrock aquifer, with contamination being present in mainly the overburden aquifer. The vertical groundwater gradients at the Site do not exhibit a strong downward component under non-pumping conditions, and based on the results of drilling activities, it does not appear that the bedrock aquifer has been impacted. The bedrock aquifer is not the primary source for supply in the Borough since a relatively plentiful public supply is easily obtained from the overburden aquifer.

A PDI was performed by HDR/O'Brien & Gere Joint Venture (HDR/OBG) as described in Section 2.6.2 to install additional monitoring wells, perform groundwater sampling, and conduct pump testing to better understand and define the plume. Groundwater sampling events were performed in June 2009 and March 2010. The conceptual re-alignment of the plume is shown on Figure 2-3. Detected CVOC contaminant concentrations sampled from wells within the plume, include PCE, TCE, cis-1,2-dichloroethene (cis-1,2-DCE), and 1,1-dichloroethene (1,1-DCE), which is consistent with results from previous investigations. Being the highest in concentration, the key indicator parameter for the EM/WS area is PCE. The highest PCE concentrations center on the 2 Wall Street Building area and decrease downgradient to the northeast. The boundaries of the plume have been delineated to the north and south; specifically for the purpose of evaluating the current extraction well network and its capture zones as shown on Figure 2-3. The boundary has been delineated as the 10 μg/L PCE boundary.

As shown in Figure 2-3, the source area of the PCE plume was found to be near overburden well MW-1A, where a PCE concentration of 16,000 parts per billion (ppb) was found. This concentration is in excess of 10 percent of the solubility limit of PCE suggesting that dense non-aqueous phase liquid (DNAPL) may be present in this area. The source area for the EM/WS plume is being addressed by OU4 of the site. From MW-1A, the plume migrates in the northeasterly direction. In the vicinity of Mott Place, the maximum concentrations were observed at PZ-7 with a PCE concentration of 2,200 ppb. In the vicinity of Halsey Avenue, the maximum concentrations were encountered PZ-10A with a PCE concentration at 374 ppb. PCE concentrations decreased to approximately 241 ppb at PZ-11B, located near the intersection of Maple and Jackson Avenues. At the downgradient fringes of the plume, the Rockaway Borough supply wells had concentrations of 86 ppb and 23 ppb at GW-1 and GW-6, respectively.

Based on the CVOC samples results from the PDI, the groundwater treatment facility (GWTF) influent maximum concentrations for PCE, TCE, cis-1,2DCE, and 1,1-DCE were estimated to be approximately 5100, 25, 7 and 2 ppb, respectively. All other VOC concentrations were either non-detect or below the method detection limit from this and previous investigations.

2.6 Remedial Design

The following subsections summarize the major phases of the RD.

2.6.1 PRP Design

PRP design was completed by CRA on behalf of ATK. The Preliminary (35%) Design Report and a subsequent July 31, 1996 Technical Memorandum recommended a remedial scenario that involves the installation of three groundwater extraction wells (one source control and two plume control) in the EM/WS Plume. These three wells were designed to collectively pump approximately 180 gpm for treatment with an air stripper and off-gas vapor carbon in a treatment plant located in the Rockaway River Park along Jackson Avenue. Treated water was designed to gravity discharge into a storm sewer system and ultimately to the Rockaway River under a New Jersey Pollutant Discharge Elimination System (NJPDES) Discharge to Surface Water (DSW) permit.

After submittal of the Preliminary (35%) Design, the Intermediate (65%) Design was prepared and submitted in December 2002. In the 2002 Intermediate (65%) Design report the following activities were described and discussed:

- Two rounds of groundwater sampling in 1999 and 2001 from selected EM/WS Plume monitoring wells to confirm groundwater quality conditions;
- Geotechnical boring for the initial EM/WS Treatment Building design;
- Phase IB and Phase II Cultural Resources Survey;
- Hydrogeologic modeling;
- Utility location identification; and
- Identification of permit applications to construct and operate the EM/WS Plume treatment system.

After submittal of the Intermediate (65%) Design Report, Rockaway Borough decided not to grant access to the original EM/WS treatment building location. A new groundwater treatment building location was mutually selected by Rockaway Borough and EPA. Based on the new building location and forcemain route additional field activities had to occur including utility location identification, geotechnical borings, and a cultural resources survey.

The results of the new field activities were presented in the Revised Intermediate (65%) Design report. Design parameters were also presented that describe the EM/WS Plume system concerning the influent characteristics, extraction well flow rates, estimated mass loading, and off-gas air quality. The parameters show that the EM/WS Plume treatment system could remove an estimated VOC concentration of approximately 1,000 ppb, or 900 pounds (lbs)/year from the groundwater. This VOC mass can be readily treated to meet NJPDES-DSW discharge criteria using a shallow tray air stripper with off-gas vapor treatment.

On September 9, 2005, EPA provided no comments to the Revised Intermediate (65%) Design Report and requested submittal of the Pre-Final (95%) Design Report by the end of September. On September 28, 2005, CRA, on behalf of ATK, submitted the Pre-Final (95%) Design Report to EPA.

The Pre-Final (95%) Design Report involved further preparation of the treatment system design including intermediate pre-final plans, specifications, and drawings. On November 9, 2005, EPA submitted comments to ATK on the Pre-Final (95%) Design Report.

The final design involved pumping groundwater from three extraction wells through a 2-inch carrier pipe double containment force main from EW-5 and a 3-inch carrier pipe double containment force main from EW-6 and EW-7 into the treatment building. The influent water would not require pretreatment before entering a 2,100 cubic feet per minute (cfm) shallow tray air stripper followed by vapor treatment before being discharged to the atmosphere. The treated water would be discharged by gravity through an 8-inch polyvinyl chloride (PVC) storm sewer pipe to an existing storm sewer manhole located near the building. The existing storm sewer pipe at the connection point is reinforced concrete pipe and subsequently outfalls to the Rockaway River.

2.6.2 Design Changes

CAPE was tasked with the RA, through its PRAC W912DQ-05-D-0001, Task Order 0005. RA scope included pre-mobilization activities such as permitting and extraction well installation. CAPE reviewed the CRA design and determined that it could be improved by combining the effluent from the extraction wells into a common force main. EPA and USACE consented to this change.

During the permit coordination meeting between EPA, NJDEP, USACE, CAPE, and CDM Smith on August 15, 2006, it was determined that the Rockaway River Park lot designated for the GWTF was encumbered by NJ Green Acres Program (GAP) funding. As a result, during a subsequent meeting with Rockaway Borough, NJDEP, EPA and USACE on January 10, 2007, EPA determined that it would re-locate the groundwater treatment plant building to the Borough-owned property at the intersection of Jackson Avenue and Ogden Avenue; Block 14, Lot 18. In a letter dated March 30, 2007 NJDEP agreed to allow the construction of EW-7 in Memorial Park, provided above-ground structures associated with the well do not interfere with public use of the park. This letter is included as **Appendix V**.

CAPE installed 3 extraction wells specified in the CRA design, EW-5, EW-6 and EW-7, between May and October 2007, and pump-tested the wells in October 2007.

On August 22, 2007, CDM Smith began design revisions to locate the groundwater treatment building to Block 14, Lot 18. The groundwater influent force main trench portion of the design was separated from the treatment system to move it forward while the building design issues were resolved.

On October 25, 2007, EPA, USACE, CAPE, and CDM Smith met with representatives from the Borough of Rockaway to discuss treatment facility alternatives. Due to the location of an existing well house at the site that houses one of the Rockaway Borough potable water supply wells, GW-1, the existing well house needed to be demolished due to severe space constraints as described in Section 2.6.4.2. As a result of that meeting, a Request for Proposal (RFP) was issued on November 16, 2007 for CAPE to provide construction, design and incidental support to incorporate the Borough water supply well into the planned treatment facility.

EPA, USACE, CAPE, and CDM Smith met with NJDEP on December 19, 2007 to discuss the plans for a combined extraction well and GWTF in the same building in separate rooms, with mechanical and structural safeguards. NJDEP advised that the demolition of the existing building at GW-1 triggers a Safe Drinking Water permit requirement, regardless of any changes made to the pump. NJDEP also agreed that dual wall high density polyethylene (HDPE) pipe with leak detection is a suitable means of conveying the non-potable flow from the extraction wells to the treatment plant when force main is within 10 feet of a water main, provided that the force main is below the water main.

Following the December 19, 2007 meeting, NJDEP advised that it could not sanction a waiver from the Safe Drinking Water Act requirements, and implied that EPA should provide the waiver. On February 13, 2008 EPA issued an Applicable or Relevant and Appropriate Requirements (ARAR) waiver letter, enabling the combined building to proceed. This letter is included in **Appendix W**.

CAPE submitted the draft pump test report for the newly installed extraction wells on January 18, 2008. The Trench Design for the revised facility location was submitted on February 15, 2008. CAPE submitted the proposal for the combined building design & construction on March 4, 2008.

Work was halted, following review of the CAPE/CDM Smith draft pump test report, after it became clear to EPA that additional information regarding the aquifer was required. In April and May 2008, a series of meetings were held between EPA, USACE, CAPE and CDM Smith to discuss the ability of extraction wells EW-5, EW-6, and EW-7 to effectively capture the contaminant plume. It was agreed during these meetings that 10 new monitoring wells would be installed, in addition to the collection of geological and hydrogeological data, to confirm the groundwater contours in this area and resolve the uncertainty with capturing the contaminant plume.

2.6.3 Pre-Design Investigation

In April 2009 EPA proceeded with the study using HDR/OBG, and in January 2010 using Lockheed Martin Scientific, Engineering, Response & Analytical Services (SERAS), a Removal Branch contractor, to install additional monitoring wells, sample and conduct a pump test to better define the plume.

Initial work efforts for the PDI focused on compiling and reviewing existing information and data for the Site as well as the completion of a well inventory/usability survey. The results of these tasks were summarized in HDR/OBG's Final Technical Memorandum dated April 10, 2009. Specific data gaps identified in the memorandum included:

- A general lack of data in the area of the park located northeast of the EM/WS source area and source control extraction well EW-5;
- The large majority of wells that exist across the Site do not extend vertically to the bottom of the overburden;

- Contamination in the overburden at depth and at the bedrock/overburden interface has not been fully characterized to date;
- There are no bedrock wells to provide characterization data for the EM/WS plume; and
- The presence of DNAPL has not been addressed.

Based on these data gaps, the memorandum outlined the objectives of the PDI which included:

- Installation of monitoring wells and piezometers to supplement existing remedial investigation (RI) groundwater data and aid in the evaluation of the groundwater pathway and extent of contamination. Screening groundwater samples were proposed from the deep overburden wells installed at three locations to determine if bedrock wells were needed. Soil samples were proposed for geotechnical analysis of grain size to assess geologic conditions in the water-bearing zone at each location. Once installed, the newly installed wells and select existing wells were proposed for sampling with analysis for VOCs to assess the current extent of groundwater contamination.
- Performance of an aquifer test (72-hour pump test) to determine the anticipated long-term capture zone of the three existing extraction wells (EW-5, EW-6, and EW-7).

Based on the results of the PDI, additional field activities were undertaken by EPA in 2010. Additional nested piezometers were installed at four locations and groundwater samples were collected for VOC analysis.

In May 2010 HDR/OBG submitted the Final PDI report, which recommended;

- Eliminating EW-5 and EW-7 from the extraction well network, since they were not optimally located with respect to the plume as determined by the results of the PDI sampling. These wells were recommended to remain in place for future monitoring.
- Installing 4 new extraction wells, EW-5A, EW-8, EW-9, and EW-10, in locations determined by the conceptual model to be within the plume. EW-6 was recommended to be retained as an extraction well.

Based on the results of the PDI, the anticipated combined flow from the five extraction wells to achieve capture of the majority of the groundwater plume was determined to be 155 gpm. A conceptual re-alignment of the extraction well network and transmission piping is shown on **Figure 2-3**.

2.6.4 Summary of Remedial Design

2.6.4.1 Groundwater Treatment System

The final design specified pumping groundwater from five extraction wells installed within the plume area through a force main to a new GWTF located at the intersection of Jackson Street and Ogden Avenue. The location of the extraction wells and new GWTF building are shown on **Figure 2-4** and the GWTF site plan is shown on **Figure 2-5**. The new force main was specified to be constructed of 2 to 4-

inch diameter double contained HDPE carrier pipes. The GWTF treatment train consists of a bag filter, low-profile air-stripper and two vapor phase GAC units. An in-line heater was specified on the air-stripper off-gas line to improve the efficiency of the carbon. A schematic line diagram of the treatment train is shown on **Figure 2-6**. The treated water was to be conveyed by gravity through an 8-inch diameter HDPE pipe for discharge to an existing storm drain manhole located near the new building. The storm drain manhole is part of the Rockaway Borough's storm drainage system, which eventually discharges at an outfall at the Rockaway River. The GWTF effluent will be discharged in accordance with a NJPDES-DSW Permit equivalency. The surface water discharge criteria are included in **Table 2-2**. The facility air emissions will be controlled by the NJDEP Air Pollution Control Permit equivalency, and the air permit criteria are included in **Table 2-3**.

GWTF influent CVOC concentrations were estimated based on groundwater monitoring well data collected during the PDI groundwater monitoring events. The treatment facility was designed to treat total VOC concentrations of approximately 5,100 ppb, consisting primarily of PCE. This is a conservative estimate because it is unknown how much the high concentrations observed at MW-1A (16,000 ppb) will impact EW-5A. In addition, a conservative approach was used because the wells sampled during the PDI were not located within the most contaminated portions of the plume.

According to the results of the pump tests performed during the PDI in June 2009, it was estimated that a combined flow from the five extraction wells (existing well EW-6 and new wells EW-5A, EW-8, EW-9, and EW-10) of 155 gpm will achieve the remedial goals. However, the groundwater treatment system was designed for a flow rate of 210 gpm to allow for additional capacity, if required, which is based on the peak design flow rate specified in the CRA design. To finalize the influent force main and extraction well pump designs, more specific flow rate information for each extraction well was required. On August 2, 2010 a meeting was held with representatives from USACE, CAPE, HDR/OBG and CDM Smith to discuss the extraction well flow rates. Based on the PDI results and the meeting discussions, it was agreed that the extraction well pumps and influent force main piping would be designed for an operational range as listed below to provide operational flexibility in the field. In addition, the flexibility was required because actual hydraulic data from the extraction wells was not available because the wells had not been installed yet with the exception of EW-6. Extraction well pumping rate ranges were determined as follows:

- EW-5A – 20 to 60 gpm
- EW-8 – 20 to 60 gpm
- EW-9 – 20 to 60 gpm
- EW-10 – 40 to 100 gpm
- EW-6 – 40 to 100 gpm

After the extraction wells were installed and pump testing on the wells was conducted, hydraulic modeling to confirm the influent force main pipe diameters and determining the appropriate extraction well pumps was performed. Based on the results of the hydraulic modeling and conversations with the extraction well pump vendor, the following conclusions and recommendations were provided.

- Due to the significant draw down encountered during the pump testing performed at EW-5A, the operational range for EW-5A was limited to 50 gpm because it is unlikely that the required 5-foot pump submergence requirement specified by the pump vendor would be achieved with the pump operating at 60 gpm.
- It was determined that a shroud would be included for the pump located at EW-6. The shroud is required for adequate cooling of the pump located within this 10-inch diameter well (all other wells were installed with a 6-inch diameter casing and will therefore yield a greater velocity around the pump motor).
- The extraction well pump vendor's representative indicated that the pumps are unable to run at less than 50 percent speed (in hertz) using the variably frequency drives (VFDs). In order to operate some of the extraction wells at the lower end of the operating range for certain scenarios, the flow will have to be reduced by throttling the gate valve located in the extraction well vault.

2.6.4.2 Rockaway Borough Well House

Due to the location of an existing well house at the site that houses one of the Rockaway Borough potable water supply wells, the existing well house was required to be demolished due to severe space constraints. Due to the unknown firewall rating of the existing well house, a 20-foot separation was required to be maintained between the well house and the new GWTF per the 2006 International Building Code (IBC). Space did not exist on the property to construct the new GWTF with this separation. A new well house for the existing water supply well was therefore incorporated into the new building. The new well house with the associated existing supply well, salvaged well pump and new valves, water meter and appurtenances, etc., are located in a separate room adjacent to the new GWTF being constructed within the same new building structure. The wall constructed between the new GWTF and the supply well house rooms is solid without penetrations, except for the GW-1 drain line to the GWTF sump. The only access to the supply well house is through an outside, dedicated man door that leads directly into the supply well house, and through an access hatch located in the roof.

2.6.4.3 Flood Hazard Area Design Provisions

The new building structure and GWTF, and a portion of the new force main constructed along Jackson Avenue, are located in the regulated flood hazard area, specifically the flood fringe, of the Rockaway River. The design of these items was performed in accordance with the Flood Hazard Area (FHA) Control Act Rules at New Jersey Administrative Code (N.J.A.C.) 7:13. The structure is a utility building and is therefore not considered a habitable building by the definition under N.J.A.C. 7:13-1.2. It is estimated that the groundwater treatment system portion of the building will be accessed less than one hour per week, and the supply well house portion of the building will only be accessed by Rockaway Borough personnel as required to ensure proper operation of the supply well.

N.J.A.C. 7:13-10.4 sets forth the specific design and construction standards that apply to any regulated activity in a flood fringe. Specifically, this rule addresses the zero-net fill requirement. The site features constructed as part of this project will displace flood storage volume and so an equal compensatory volume was required to be created. The site features that will displace flood storage volume include the building (for the new GWTF and the existing Rockaway Borough supply well), which is dry-flood proofed and an outdoor concrete equipment pad for the vapor phase GAC units and associated piping. Flood storage volume was created by demolition of the existing well house (only volume for building foundation was included because it is unlikely the existing building is dry flood-proofed) and through site re-grading. The net volume filled including a 25 percent safety factor is approximately 40 cubic yards (CY). To compensate for the flood storage volume displaced, compensatory flood storage volume of at least 40 CY was created offsite on Borough of Rockaway municipal block 40, lot 76, known as the Gee property. The Gee property is shown on Figure 1-1.This compensatory flood storage volume parcel of property is owned by the Borough, and is located at the intersection of Nichols Drive and Mannino Drive, as further described in Section 3.3.6. Use of the Gee property was approved by Rockaway Borough in a resolution dated September 9, 2010, as described in Section 3.1.5.

The building has been designed as dry flood proofed up to the Flood Hazard elevation of 516 feet above mean sea level (amsl) National Geodetic Vertical Datum (NGVD) 1929 so that water cannot enter the structure during a flood event. A solid reinforced concrete stem wall is used to resist the flood force in accordance with Federal Emergency Management Agency (FEMA) Coastal Construction Manual, Table 11-6, case 4. For the GWTF portion of the building, the top of the stem wall is at the Flood Hazard elevation of 516 feet amsl NGVD 1929. The stem wall is penetrated with a flood resistant door that is designed to prevent flood waters from entering. The flood resistant door has been certified by the door manufacturer to resist the flood design loads for this project. For the well house portion of the building, the building has been flood-proofed by setting the finished floor elevation at the flood hazard elevation of 516 feet amsl NGVD 1929. Because the finished floor elevation has been set at the flood hazard elevation of 516 feet amsl, a flood proof pedestrian door for the well house room is not required. The building is designed to withstand the following load conditions:

- hydrostatic pressure up to the flood hazard area design flood elevation
- impact from water and debris during the flood hazard area design flood
- uplift, flotation, collapse and displacement due to hydrostatic and hydrodynamic forces resulting from the flood hazard area design flood
- overturning and sliding pressure

Scouring around the building is not expected to occur due to the expected velocity of the flood waters. The flood waters are expected to have a low velocity associated with rising flood waters rather than swift current.

The vapor phase GAC units are located on an outdoor concrete equipment pad and were installed above the flood hazard elevation of 516.00. Although the building is dry flood-proofed, as an additional precaution, all electrical equipment was placed above elevation 517 feet amsl with the exception of the GWTF effluent flowmeter transmitter which is required to be close to the building floor because it is located on the effluent line, which is a gravity main. However, the flowmeter transmitter poses no safety risk if it is exposed to water.

A check valve was installed on the GWTF effluent gravity line to prevent any back surge from the Borough's stormwater drainage system from entering the building. In addition, a level control switch was installed in the existing drain manhole into which the GWTF effluent gravity line discharges, which will shut down the groundwater treatment system if a high water level is encountered in the drain manhole.

The stormwater catch basins and influent force main cleanout manhole were designed by the pre-cast concrete manufacturer to withstand uplift/flotation/hydrostatic pressures caused by the flood waters. The clean-out manhole was furnished with a water-tight hatch.

2.6.4.4 Stormwater Drainage

The construction of the new GWTF and building structure did not result in new impervious surface of more than one-quarter acre or total land disturbance of more than one acre, therefore this project is not considered a "major development" under N.J.A.C. 7:8. Therefore, the Stormwater Management Rules do not apply to this specific project. Although NJDEP's Stormwater Management Rules do not apply, site modifications for the purposes of controlling stormwater flow across the site were accomplished through grading the property to direct stormwater flow into two new catch basins and associated drainage pipes that will flow by gravity to an existing stormwater inlet on Jackson Avenue that eventually discharges to the Rockaway River through the Borough's stormwater drainage system. All stormwater that falls onto the property will be captured in the new stormwater catch basins.

A stormwater runoff analysis was performed using the United States Department of Agriculture Soil Conservation Service (USDA SCS) Technical Release 55 (TR-55) modeling program. Peak rates of runoff were analyzed for 2, 10, 25 and 100-year 24-hour frequency storms using rainfall distribution Type III. The 24-hour rainfall distribution data for the site are taken from National Resources Conservation Service – New Jersey 24 Hour Rainfall data for Morris County, NJ. Based on the data collected during the geotechnical borings performed at the site, the soil hydrologic group for the site soils is considered to be group "A" or group "B". A soil hydrologic group of "B" was used for calculations for both the existing and proposed conditions as a conservative approach. The 10-inch PVC drainage pipes were sized and sloped to flow at less than 60 percent full (by depth) for a 25-year design storm and less than 75 percent full (by depth) for a 100-year design storm.

Section 3
Remedial Construction Activities

This section summarizes the scope and sequence of RA construction activities completed at the Site. Construction activities were performed in accordance with the RD requirements and the approved RA construction submittals.

A list of CAPE's subcontractors and their roles is summarized on **Table 3-1**. Select photographs of the construction activities are provided at the end of this section.

3.1 Pre-Construction Activities

Pre-construction activities included site visits, meetings, preparation of pre-construction submittals, permitting, pre-construction video and photograph logging, and site surveying.

3.1.1 Notice to Proceed

CAPE was issued the Notice to Proceed (NTP), under PRAC No. W912DQ-05-D-0001, Task Order 0005 on May 25, 2006.

3.1.2 Design

The project includes the design and construction of a new groundwater extraction and treatment system to address the EM/WS PCE-contaminated plume associated with the Rockaway Borough Superfund Site. The final design includes the construction of a new groundwater extraction and treatment system in accordance with the September 30, 1991 ROD issued by the EPA. The final design included pumping groundwater from five extraction wells installed within the plume area through a new force main to a new GWTF and building located at the intersection of Jackson and Ogden Avenues. The location of the extraction wells and new GWTF building are shown on **Figure 2-4** and as-built drawing Sheet G-2 of the Groundwater Treatment Facility Package Drawings. The new force main was constructed of 2 to 4-inch diameter double contained HDPE carrier pipes. The GWTF treatment train consists of a bag filter, removable tray air-stripper and two vapor phase GAC units. The treated water is conveyed by gravity through an 8-inch diameter HDPE pipe for discharge to an existing storm drain manhole located near the new building. The storm drain manhole is part of the Rockaway Borough's storm drainage system, which eventually discharges at an outfall at the Rockaway River.

3.1.3 Pre-Construction Meetings

Pre-construction meetings were held to coordinate the efforts of all parties involved prior to site mobilization. Participants involved in the pre-construction meetings included representatives from EPA, USACE, NJDEP, CAPE, CRA, and CDM Smith. Below is the list of pre-construction meetings and the date each meeting was held.

Meeting	Meeting Date
Pre-Work/Partnering Session	June 29-30, 2006
Pre-Construction Conference Meeting	April 23, 2007
Pre-Construction Safety Conference	April 23, 2007

3.1.4 Pre-Construction Submittals

Following the RA Contract award, CAPE prepared and submitted the required pre-construction work plans to USACE for approval. CAPE's submittal register along with all approved work plans is located in **Appendix A**.

3.1.5 Property Access

There is a Memorandum of Agreement (MOA) between the Borough of Rockaway, Morris County, New Jersey and the EPA that permits long-term access to the property at 122 Jackson Avenue to construct, operate, and maintain the groundwater remedy for the EM/WS plume on the property where the system is currently located.

At the Mayor and Council meeting held on September 9, 2010, the Governing Body agreed to allow the EPA to utilize a portion of Block 40, Lot 76 (the Gee property) as an offsite compensation area to meet the NJDEP's zero net-fill requirement of the flood hazard area permit for the construction of the groundwater treatment plant on Jackson Avenue. The MOA was subsequently modified to allow access onto the Gee property. The MOA is included in **Appendix X**.

3.1.6 Permitting

The following permit equivalency applications were prepared and approved:

- Soil Erosion and Sediment Control (SESC) Plan Certification from the Morris County Soil Conservation District
- NJDEP Air permit Equivalency for discharge of the air-stripper off-gas to the atmosphere
- NJDEP FHA Permit Equivalency for performing work in a FHA
- NJDEP Physical Connection Permit Equivalency for two potable water connections at the site: the GW-1 Supply well and the GWTF
- NJDEP Bureau of Safe Drinking Water Permit Equivalency to Construct/Modify/Operate Public Water Works Facilities

- NJDEP Short Term Water Use Permit for the pump testing of extraction wells during construction
- NJDEP General Industrial Treatment Works Approval Permit Equivalency to approve the groundwater treatment system
- NJDEP Water Allocation Permit for extraction of groundwater by the extraction wells
- NJDEP NJPDES-DSW Permit for discharge of the plant effluent to the Borough's storm sewer system
- Rockaway Borough Road Opening Permit submitted to the Borough of Rockaway
- Borough of Rockaway Construction Permit for new construction

Copies of the permit equivalencies are included in **Appendix B**.

3.1.7 Pre-Construction Videos and Photographs

Pre-construction photographs were taken by CAPE and submitted to the USACE in April 2007, and then again after project re-start in May 2011. All existing conditions were documented, along with descriptions of photos and their location. All pre-construction photographs can be found in **Appendix C1**.

The pre-construction video was submitted on August 24, 2007, and supplemental pre-construction video for EW-7 was submitted on August 29, 2007. A second pre-construction video was recorded in March 2011, prior to trench construction, and was submitted on May 27, 2011. The pre-construction and post-construction videos are included in **Appendices C2** and **C3**, respectively.

3.1.8 Initial Site Survey

Site mapping AutoCAD files were provided by CRA at the beginning of the project. The initial site survey used for the mapping was conducted by Stewart Surveying & Engineering LLC, and was dated August 2004 and July 2005. The mapping was supplemented in subsequent civil/site surveys to focus on specific areas relevant to the design. Supplemental survey of the trench area and the building location at 122 Jackson Avenue was conducted by LAN Associates in August 2007.

Gee property mapping was provided by Spillane Engineering Associates, LLC, via the Borough of Rockaway.

All mapping uses New Jersey State Plane North American Datum (NAD) NAD27 horizontal datum, and NGVD 1929 vertical datum.

3.2 Site Preparation

3.2.1 Temporary Facilities Mobilization

During the 2007 well installation activities, CAPE installed temporary construction facilities and fencing at the property between Lakeside Drive and Wall Street (address is 9A Wall Street), also known as the

Friendship Field lot, see **Figure 3-1a** (lay-down area). This lay-down area included two mobile office trailers, a tool storage container, a decontamination pad, and an additional equipment and material staging area mobilized by CAPE. These facilities were fenced in with an 8-foot high chain-link fence for security. The project was put on hiatus in March 2008 due to uncertainty of the plume location and effectiveness of the original design. During the construction shutdown period, all storage facilities, containment structures, office trailers, waste materials, stored materials, utilities, fencing, and signs were dismantled and removed from the site. The layout of the friendship field lot during the shutdown period is shown on **Figure 3-2b**.

Upon re-mobilization in November 2010, CAPE utilized the Gee Property (see **Figure 1-1**) for storage and staging of construction equipment and materials, and material designated for off-site disposal. A decontamination pad was also constructed at the Gee Property for use during drilling. CAPE leased office space at the Pine Street Commons in Rockaway for its office operations, in lieu of trailers, to be used by EPA, USACE, and CAPE. The lay-down area at the Gee property is shown on **Figure 3-2e**. The Friendship Field lot was utilized on a limited basis during drilling and trench installation. The layout of the Friendship Field lot during this time period is illustrated on **Figure 3-2c**.

In March 2011, the lay-down area at the Friendship Field lot was required to be modified to accommodate community activities at the Borough (softball parade). The revised layout is shown on **Figure 3-2d**.

3.2.2 Site Security

The site is spread throughout the Borough of Rockaway, with the building location at 122 Jackson Avenue, individual extraction well locations and trench at the police station property and on Mott Place, Maple, Halsey, and Jackson Avenues, and the lay-down yard at Friendship Field lot were each secured using temporary chain-link fencing, supplemented by jersey barriers for road construction locations as warranted. Rockaway Borough police were utilized for traffic control as needed, depending on work locations. The Gee property was used as an equipment and material storage and staging area. This property was secured by an existing chain link fence and locked gate, which was in place prior to use by CAPE.

3.2.3 Equipment Decontamination Facilities

A decontamination pad was located in the lay-down area shown on **Figures 3-2a,** and **3-2c** for drill rig and large equipment decontamination. Wastewater from equipment decontamination and construction activities were stored in closed containers on-site and treated with the on-site temporary treatment systems described in Sections 3.3.1.1 and 3.3.1.3. Decontamination of sampling equipment took place in the area of each well location.

3.2.4 Soil Erosion and Sediment Control

On CAPE's behalf, CDM Smith prepared a SESC Plan for the site remedial activities and submitted it to the Morris County Soil Conservation District for certification. The approved SESC Plan outlined the procedures to be implemented during construction, soil excavation, backfill, and grading operations. Upon commencement of mobilization, prior to ground disturbance, and following clearing activities, CAPE installed erosion control measures throughout the site in accordance with the approved SESC

Plan. SESC measures consisted of a stabilized construction entrance to the facility to reduce soil erosion near the site entrance, filter fabric in the grate of the stormwater inlet near the site, a siltation barrier around the perimeter of the site, a siltation barrier around new extraction well EW-7, and restoration of grass around the perimeter of the building.

3.2.5 Site Clearing

Clearing at the building site at 122 Jackson Avenue consisted primarily of trimming trees on the adjacent railroad property with limbs overhanging the building site. One tree, located in the southwest corner of the property, and several small trees along the north property line, were cut and the stumps were removed. One small section of fence in Memorial Park was removed to install the trench, and was replaced after installation. Small sections of curb and sidewalk were removed to install the piping trench. Tree removal and chipping of trees at 122 Jackson Avenue was conducted by M&A Tree Service. Chipped tree debris was staged at the Gee Property and mixed with non-hazardous site soils and shipped to Soil Safe Inc. in Logan Township, NJ.

3.2.6 Building Demolition

The existing well house, which contained water supply well GW-1, was demolished to make room for the new combined building housing the groundwater treatment facility and GW-1. Prior to demolition, an asbestos assessment was conducted by a New Jersey certified Building Inspector from TTI Environmental, Inc. The lead evaluation and asbestos survey is included in **Appendix D**. The assessment identified asbestos-containing material (ACM) in three of the brick walls, the ceiling, and the well pump. ACM was removed from GW-1 on November 24, 2010. Building demolition was conducted on December 13 and 14, 2010. A void space approximately 3.5 feet from the top of the well casing to the top of the finished floor was noticed after the removal of the well pump. CAPE extended the well casing and backfilled the void with structural fill. All demolition debris was staged at the Gee property prior to off-site disposal. **Photo 3** shows the demolition.

3.2.7 Waste Disposal Staging Area

The lay-down yard located at Friendship Field's parking lot was initially used as a waste disposal staging area, from May 2007 until March 2008. During this period the drilling subcontractor stored drums and roll-off boxes containing drill cuttings from the pilot borings. A 20,000 gallon frac tank was also kept in the lay-down yard and was used to store decontamination water and water from well development. All waste was removed from the site prior to demobilization in 2008. Waste disposal records are in **Appendix E**.

Upon re-mobilization in November 2010, the Gee property was used to stage excavated soil, including trench spoils, soil excavated from the building property at 122 Jackson Avenue, and drill cuttings from the pilot borings and well installation, as well as demolition debris from 122 Jackson Avenue and asphalt and concrete removed from the trench alignment. At the Gee property the waste was sampled according to disposal facility requirements for chemical and geotechnical parameters prior to off-site disposal at the appropriate facility. The Gee property was secured as discussed in Section 3.2.2, and waste awaiting disposal was contained in covered stockpiles or roll-off containers as appropriate.

3.3 Site Work

3.3.1 Well Installation and Development

3.3.1.1 2007 Extraction Well Installation

Extraction wells EW-5, EW-6, EW-7, and EW-7A were installed between May 21 and September 26, 2007 by B&B Drilling of Netcong, NJ, with CDM Smith performing field oversight and well screen design. The drilling process at each location began with drilling a pilot boring with continuous split spoon sampling, to identify the appropriate screen interval, and collect data to be used to design filter pack and screen size. Samples were collected and analyzed for grain size distribution by method American Society of Testing and Materials (ASTM) D-422 at CDM Smith's geotechnical laboratory in Cambridge, MA. Grain size information was used in the well screen and filter design. Pilot borings were completed between May 21 and June 1, 2007. Drilling fluid used during pilot boring installation was collected in a lined covered roll-off container at the pilot boring location. Water was periodically siphoned from the roll-off by a vacuum truck, and transported to the storage tanks in the lay-down yard in Friendship Field lot.

Drilling for the extraction well installation began following well screen and filter pack design, submittal to USACE and EPA, and approval. Well installation drilling began August 16, 2007. Installation was completed using a Foremost DR-24 Dual Rotary Barber Rig. Drill cuttings were stored in roll-off containers at the drilling site, and then transported to the lay-down yard for subsequent sampling and disposal off-site.

B&B Drilling developed the wells using air lift method at all wells, supplemented by surge block at EW-5 and EW-7A, and surge block and jetting at EW-7. CDM Smith recorded water quality readings during development, including depth to water, pH, specific conductivity, dissolved oxygen, redox potential, and turbidity. Development ceased when readings stabilized. Well development water was pumped into a sealed roll-off container at the well location. Subsequently a vacuum truck was used to empty the roll-off and transport the water to the storage tank in the lay-down yard. This water was later treated with the mobile treatment system, and disposed in accordance with the approved temporary discharge permit.

Step-drawdown and pump testing was conducted between October 15 to 26, 2007. EW-5 and EW-7 were pump tested for 24 hours, and a 72-hr pumping test was conducted on EW-6. EW-7A was used to monitor water levels during pumping at each of the extraction wells. During step-drawdown and pump testing, water was treated at the wellhead with a mobile treatment system, consisting of a bag filter and liquid-phase carbon, which was supplied by Groundwater Treatment Technologies, Inc. (GTTI) and operated by Bigler Associates, Inc. (BAI). Water was discharged into the storm sewer, which ultimately discharges to the Rockaway River. The discharge was permitted by NJDEP under the Temporary Discharge to Surface Water permit equivalency, which is located in **Appendix B**.

The original design included 3 extraction wells; EW-5, EW-6, and EW-7, as shown on **Figure 2-3**. During drilling of the pilot boring at EW-7, a pervasive silt layer was noted within the intended screen zone. This silt layer caused concern regarding the potential impact on the radius of influence in this location. USACE requested a proposal from CAPE to install a piezometer in the vicinity of EW-7. The piezometer was labeled EW-7A. The intent was to convert it to an extraction well if needed to supplement EW-7. It was later determined, based on the results of additional monitoring and sampling discussed in Section 3.3.1.2, that EW-5, EW-7, and EW-7A were not optimally located, and would not be used as extraction wells but will be retained for use in future monitoring and sampling. EW-6 was retained as an extraction well, and it was incorporated into the extraction well network installed in 2011, which is described in Section 3.3.1.3. Well construction information for all extraction wells installed in 2007 is located in the table below.

All wells were finished with flush-mount road boxes. At EW-6, this flush-mount box was replaced with a manhole during installation of the extraction well pump and pitless adapter.

Table 3-2
2007 Well Installation Summary

Well ID	Well Diameter /Material	Total Depth (ft bgs)	Screen Interval Depth (ft bgs)	Screen Opening	Filter Interval Depth (ft bgs)	Filter Material
EW-5	8-inch 304 stainless steel (SS)	97	62 – 87	12 slot	57 – 97	Custom blend*
EW-6	10-inch 304 SS	83	46 – 76 +	40 slot	42 – 83	#2 Sand
EW-7	10-inch 304 SS	98.5	86 – 91	20 slot	82 – 98.5	#1 Sand
EW-7A	6-inch 304 SS	85	69 – 74	20 slot	65 – 85	#1 Sand

*Custom blend for EW-5 is sand with d_{50} = 0.027 in, with uniformity coefficient of 4.

+ Screen is not continuous. Tight-wrap was placed at 51-61 ft bgs, and 64-68 ft bgs to blank these intervals.

Soil cuttings from drilling and extraction well installation were initially stored in 55-gallon Department of Transportation (DOT) drums before being transferred by CAPE to a soil roll off container at the staging area. Drilling mud generated as part of the extraction well activities was transferred by B&B Drilling to an Adler tank at the staging area. Water generated by development and step testing activities was treated by a mobile treatment system unit (bag filters and carbon vessel) and discharged to storm drains under the previously approved NJPDES DSW permit equivalency. The treatment system was supplied by GTTI and operated by BAI.

The 10-foot well casing in EW-6 was too large to maintain a minimum velocity flowing around the pump to keep it cool, and thus has an 8-inch flow inducer shroud was installed to maintain this flow.

3.3.1.2 Additional Monitoring and Sampling (HDR & SERAS)

To confirm the groundwater contours in this area and resolve the uncertainty of the capture of the contaminant plume near EW-6, geological, hydrogeological, and chemical data were collected during the PDI, as described in Section 2.6.3. In May 2010, HDR submitted the Final PDI report, which recommended the elimination of EW-5 and EW-7 from the extraction well network since they were not optimally located with respect to the plume and installation of four new extraction wells, EW-5A, EW-8, EW-9, and EW-10, in locations determined by the conceptual model to be within the plume with EW-6 retained as an extraction well.

3.3.1.3 2011 Extraction Well Installation

Extraction wells EW-5A, EW-8, EW-9, and EW-10 were installed in stages between December 2010 and August 2011. Pilot borings were first drilled in December 2010, to collect geotechnical information used for designing well screen and filter design. Pilot borings were installed by Frontz Drilling, Inc. of Wooster, OH between December 14 and December 21, 2010. Frontz Drilling activities were overseen by a NJ-licensed driller, B. L. Meyer Bros. of Manahawkin, NJ. CDM Smith performed field oversight and collected samples for grain size analysis, to be used for well screen and filter design. Following well design, Miller Drilling of Lawrenceburg, Tennessee mobilized to the site and completed the installation, development, and step-drawdown testing of the extraction wells between March 7 and April 5, 2011. Miller Drilling's activities were also overseen by B. L. Meyer Bros. of Manahawkin, NJ. CDM Smith performed field oversight. The well installation oversight report is included in **Appendix F**. Well installation summary follows:

Table 3-3
2011 Well Installation Summary

Well ID	Well Diameter /Material	Total Depth (ft bgs)	Screen Interval Depth (ft bgs)	Screen Opening	Filter Interval Depth (ft bgs)	Filter Material
EW-5A	6-inch 304 SS	80	63 – 73	25 slot	58 – 80	#0 Sand
EW-8	6-inch 304 SS	87	65.5 – 80.5	30 slot	60 – 87	#1 Sand
EW-9	6-inch 304 SS	72	55 – 65	30 slot	50 – 72	#1 Sand
EW-10	6-inch 304 SS	75	52 – 67	30 slot	47 – 75	#1 Sand

Miller Drilling performed development and step testing of all wells. Extraction wells were developed by surging and purging methods. Step drawdown testing was performed by pumping each well at four different pumping rates and maintaining each rate for 2 hours, and monitoring the drawdown.

Soil cuttings from drilling and extraction well installation were initially stored in 55-gallon DOT drums before being transferred by CAPE to a roll-off container at the staging area. Water generated by development and step testing activities was treated by a mobile treatment system unit (bag filters and carbon vessel) and discharged to storm drains under the previously approved NJPDES DSW permit equivalency. The treatment system was supplied by GTTI and operated by BAI. Extraction well installation and development are shown in **Photos 1 and 2.**

Extraction well details were finalized based on the results of the step-drawdown testing. This included a re-evaluation of the system hydraulic calculations to finalize the pump design, pump inlet and level transducer settings, and riser pipe sizing. The hydraulic calculations were summarized in the May 16, 2011 Revised Extraction Well Pump Evaluation memorandum, which is included in **Appendix G**. The original design specified the use of Grundfos submersible pumps. However when finalizing the well details it was determined that the Schaefer 90 gpm pump could meet the target pumping range for EW-10 (6-inch diameter well) using a 4-inch diameter pump, while the Grundfos model would have required a larger pump size to meet the pumping range. Therefore the decision was made to use Schaefer pumps for all extraction wells, to maintain consistency of equipment manufacturer.

Table 3-4
Extraction Well Pump Summary

Well ID	Pump Make and Model	Target Pumping Range (gpm)	Total Dynamic Head (ft)		Motor (HP)	Pump Inlet (amsl)	Transducer El (amsl)	Riser Pipe Diameter (in)
			Min	Max				
EW-5A	Schaefer 60 GPM	20-60*	43	172	5	495	500	2
EW-8	Schaefer 60 GPM	20-60	40	158	5	493	501	2
EW-9	Schaefer 60 GPM	20-60	41	153	5	490	498	2
EW-6	Schaefer 90 GPM	40-100	40	108	5	486	494	3
EW-10	Schaefer 90 GPM	40-100	37	103	5	476	484	3

*Target pumping range for EW-5A was later adjusted to 20 – 50 gpm following step-drawdown test, due to concerns regarding minimum submergence depth.

The 10-inch diameter well casing in EW-6 was too large to maintain a minimum cooling velocity, therefore this pump was fitted with an 8-inch flow inducer shroud.

Installation of extraction well pumps, riser pipes, and pitless adapters was completed in summer 2011 by A.C. Schultes of Woodbury Heights, NJ, in connection with the well vaults, trench, and forcemain installation in summer 2011.

3.3.2 Groundwater Treatment/GW-1 Building Construction

3.3.2.1 GW-1 Demolition

The well house building around GW-1, the slab, the concrete sidewalk, the sidewalk and concrete curb to the west of the well house, and associated electrical components and electrical service were demolished while the well pump was salvaged. CAPE removed these components at GW-1 due to the lack of structural integrity with the intention of rebuilding the well house in the same location, with a completely separate room as the GWTF as described in Section 3.3.2. The existing pump was restored after the building was complete, as described in Section 3.3.5. A temporary bypass pump was provided in the interim, described below.

3.3.2.2 GW-1 Temporary Bypass

A bypass pump was put in place while the GW-1 facilities were being demolished and the new GWTF was being constructed to provide drinking water for the town. This was a VFD temporary submersible pump with a minimum flow of 200 gpm and maximum flow of 350 gpm. The piping from the submersible pump tied in to the Rockaway Borough raw water main that provides water to the Borough. The operation and control logic for the temporary bypass pump was similar to the preexisting setup, except for the addition of a soft start drive. A temporary generator with the capacity to run the temporary bypass submersible pump was on hand to supply power to GW-1 once the existing electrical service was disconnected by Jersey Central Power and Light (JCP&L). However, CAPE coordinated with the Borough of Rockaway to keep the temporary bypass pump off during demolition, and the generator was not used. The pump was installed, disinfected, and placed in service with power supplied by JCP&L on January 5, 2011. The work was performed in accordance with the NJDEP Bureau of Safe Drinking Water Permit Equivalency, which is included in **Appendix B**.

3.3.2.3 Subgrade Preparation

Two geotechnical borings were performed during remedial design activities in the vicinity of the proposed treatment building location. Based on the boring information, it was determined that the subgrade beneath the building would require preparation to improve the soil bearing capacity and stability prior to pouring the foundation and construction the building. In general, the improvements consisted of excavation of the building footprint followed by controlled backfill of 6 inches of structural fill. The Geotechnical Report is included as **Appendix H**.

Upon completion of site setup activities, CAPE field crews commenced work on subgrade preparation for the proposed area for the new treatment building. The building subgrade was excavated. Excavated material was stockpiled at the Gee Property, sampled for geophysical and chemical analyses, and disposed of as appropriate. Structural fill compaction was verified by ANS Consultants, Inc. of South Plainfield, NJ to be over 95 percent of the laboratory maximum dry density and within -3 and +5 percent of the optimum moisture content using a nuclear density gauge. Field density test reports can be found in **Appendix I**. Backfill material physical test results are located in **Appendix J**. Foundation preparation is shown in **Photo 4.**

3.3.2.4 Building Foundation

The building foundation consists of reinforced concrete with traditional spread footings. The building foundation extends to the appropriate depth below finished grade in order to prevent against frost heave and general foundation movement. CAPE field crews performed all work.

The primary structural design codes and standards used in the building design are as follows:

- 2006 New Jersey IBC
- 2006 IBC
- 2005 American Society of Civil Engineers (ASCE) 7 Minimum Design Loads for Buildings and Other Structures
- 2005 American Concrete Institute (ACI) 318 Building Code Requirements for Structural Concrete
- 2005 ACI 530 Building Code Requirements & Specifications for Masonry Structures
- American Institute of Steel Construction (AISC) 13th Edition Steel Construction Manual

A vapor barrier was installed underneath the building foundation to prevent VOC vapors from entering the building. **Photos 5 and 6** show the foundation and stem wall.

3.3.2.5 Backfill and Compaction

In April 2011, structural fill from Weldon Quarry Company was placed around the GWTF footprint and compacted by CAPE. ANS Consultants performed compaction testing on the fill material; all tests passed specification requirements. Structural fill was placed in layers no thicker than 8 inches as placed and compacted to 95 percent maximum density as determined by modified proctor. The geotechnical testing that was performed included density testing, moisture content testing and field proctors. One density test was performed for every 500 CYs of material placed, with no less than one test per lift, to confirm proper compaction has been achieved. During the trench construction phase, a technician was on site daily to perform compaction testing. A minimum of one moisture-density test was performed for every 3,000 CYs of material, but no less than one test per borrow area, and sieve analysis was performed for every 3,000 CYs of material utilized.

3.3.2.6 Concrete Slabs

CAPE's subcontractor Alimi Builders, Inc. (Alimi), of Wyckoff, NJ poured the building slab and entrance stairs. The building slab has a low point finished floor elevation of 513.92 feet amsl. The building slab thickness is 10 inches, and it is reinforced with #5 reinforcing steel at 12-inch spacing each way, top and bottom. The GAC equipment pad is a 20-foot by 20-foot exterior slab on grade, located adjacent to the southwest side building. Inside the treatment facility room, an equipment pad was provided for all major process equipment including the air stripper and blower. GAC vessels, air-stripper, and blower were anchored in the field with an epoxy adhesive anchoring system.

A trench drain runs along the northwest wall in the treatment facility room. The floor surface inside the treatment facility room slopes toward the trench drain, which in turn drains to a 2.5-feet deep concrete sump. The sump was constructed for a pump that is used as needed to pump the sump contents and into the treatment train.

3.3.2.7 CMU Block Wall and Brick Veneer

The building's wall construction is comprised of reinforced twelve-inch concrete block, with a four inch thick cavity, and four inch brick veneer.

Alimi field crews installed the concrete masonry unit (CMU) block wall, cavity insulation and brick veneer for the building. CMU blocks were provided by Easton Block & Supply of Easton, PA and brick veneer was provided by McAvoy Brick of Phoenixville, PA. Installation of CMU block walls and brick veneer was completed using scaffolding for once the masonry reached the first bond beam, approximately 5 feet above the ground. Bond beams were installed at spacing as shown on the design drawings. Two continuous vertical expansion joints were installed in the CMU and brick veneer. Vertical reinforcing steel with concrete filled cells was installed at regular intervals and reinforced at openings. Pre-cast concrete lintels were installed above the masonry openings. Weep vents were installed at 16-inches on center at the base of the brick veneer. The brick veneer also has a soldier course – a layer of bricks oriented vertically – just below the top of the masonry, and above all the openings. **Photos 7 and 8** show the masonry construction in progress.

3.3.2.8 Roofing, Doors, Windows, and Louvers

The roof is made up of 8-inch thick pre-cast hollow-core planks, with a two-inch cast-in-place concrete topping, 3-inch rigid insulation, and a styrene butadiene styrene (SBS) modified bitumen roof system. Pre-cast hollow-core roof planks were manufactured by Boccella Pre-Cast, LLC, in Berlin, NJ. The hollow-core roof planks are seated on a structural concrete tie beam at the top of the masonry wall. The roof is sloped to drain to 3 aluminum scuppers with downspouts, and two overflow scuppers, one each on the east and west walls. The roof of the GW-1 well house portion of the building includes a 4-foot by 4-foot equipment access hatch, which is centered over the well to allow for pump removal and maintenance in the future. The hatch was manufactured by the Bilco Company, New Haven, CT, and installed by the roofing subcontractor, Abbott O'Reilly Contracting of Verona, NJ. Pre-cast roof panel installation is shown on **Photo 9**.

The building has one 8-foot by 8-foot aluminum double-door to the main treatment facility area on the north side of the building. This is a flood-proof door supplied by PS Doors of Grand Forks, ND, and designed in accordance with FHA regulations. The flood door is fitted with removable transom panels above the 8-foot door panels, which can be connected to the door panels with a slide bolt. When engaged and connected to the door, this creates a 12-foot high opening. The 12-foot high opening will allow equipment in the building to perform maintenance. During normal conditions the doors are operated as 8-feet high doors by disengaging the slide bolts.

One external single aluminum personnel door is also included on the west side of the building opening into the GW-1 area. The exterior door is aluminum with polyvinylidene difluoride (PVDF) coating.

The building contains three windows near on the upper portion of the building on the north, south and east walls of the structure for natural lighting into the treatment facility area and the GW-1 area. Additional interior lighting is provided by hanging light fixtures within the building. All windows are fabricated of extruded, thermally-broken, aluminum storefront system with clear, one-inch thick, insulating glazing.

The building is equipped with two intake louvers and two exhaust fans. All louvers are aluminum and storm-proof with a PVDF coating.

Rebco, Inc. of Paterson, NJ fabricated and installed the windows. The flood-proof door, man door, louvers, and exhaust fans were installed by CAPE field crews.

3.3.2.9 Building Electrical

As discussed in Section 3.3.2.2, CAPE coordinated with JCP&L prior to demolition of GW-1 well house to disconnect the existing electrical service. JCP&L also provided the permanent service to GW-1 well house and the GWTF. CAPE's subcontractor Ehrich Electric, Inc. of East Hanover, NJ conducted building electrical work initially, until it was replaced by Hi Volt Electric LLC, of Laurence Harbor, NJ. The electrical scope for the GWTF site was to install a new 480VAC 225 amp service to provide power to the treatment building and associated process equipment located at 122 Jackson Avenue. The process equipment consists of an 18 kilowatt (kW) process air heater, 40 horsepower (HP) blowers and air stripper system with carbon treatment and power for the remote extraction well pump control panel. Building loads are associated with general heating, ventilation, and air conditioning (HVAC) unit heaters and exhaust fan, 15 kilovolt-ampere (kVA) 120/208 voltage in alternating current (VAC) distribution panel for lighting, general receptacles and process instrumentation loads.

The Borough's GW-1 well house electrical service was updated to 75 kVA 120/240 VAC service. The update also included a new 120/240 distribution panel for small miscellaneous loads, a new manual fused transfer switch to accept the Borough's portable standby generator. New lighting and HVAC equipment was installed as well as a new flow meter and integrated pump controls.

Both buildings also received new card entry / security systems as well as fire detection as part of the new construction.

3.3.2.10 HVAC

Heat load calculations were performed to determine the heating and cooling requirements for both the GWTF and well house, which are conditioned separately. Worst case design temperature for the summer and winter are 94, and 11 degrees Fahrenheit (F) respectively while the inside design temperatures for summer and winter are 104, and 55 degrees F respectively. Conduction and radiation loads were used for the calculation of heat loads for the spaces. Internal loads from pumps, blowers, and lights were taken into account for the summer loads. Half of an air change an hour was used for an additional load for the winter calculation.

Ventilation cooling is used to condition the spaces in the summer, while electric unit heaters provide heating in the winter. Intake louvers are placed opposite the room from the exhaust fans to reduce the amount of stagnant air in the space. There is one exhaust fan and one louver per room. Louvers were sized based on 500 feet per minute through them. There is one louver and one fan per room of the GWTF building and GW-1. The thermostat maintains constant temperature in all rooms.

3.3.2.11 GWTF Discharge Piping

The treated effluent is conveyed by gravity through an 8-inch diameter HDPE pipe for discharge to an existing storm drain manhole located near the new building. The discharge pipe is located at the southeast corner of the GWTF and runs in between the equipment pad and railroad side-slope as shown on as-built drawing Sheet C-3, which is located in **Appendix K**. The trench was backfilled with common fill, and washed sand was placed around the conduits.

The storm drain manhole is part of the Rockaway Borough's storm drainage system, which eventually discharges at an outfall at the Rockaway River. The GWTF effluent discharge is monitored by a NJDEP NJPDES-DSW Permit equivalency. A level control switch is located in the storm drain manhole which is connected to the Programmable Logic Controller (PLC), and programmed to shut the treatment facility down during high water level conditions in the manhole.

3.3.2.12 Storm Drainage System

Although Stormwater Management Rules do not apply to this specific project as described in Section 2.6.4., site modifications for the purposes of controlling stormwater flow across the site were implemented. The site was graded for positive drainage as shown on **Figure 2-5** and as-built drawing Sheet C-3, with approximately 100 percent of the stormwater runoff from the site being directed to one of two newly installed catch basins. One catch basin was installed in the northeast corner of the site, and flow from the basin is conveyed via a 10-inch PVC drainage pipe to a second catch basin, which is located in front of the building near Jackson Avenue. Flow from both catch basins is conveyed by a 10-inch PVC pipe to an existing catch basin located on Jackson Avenue, which is part of the Rockaway Borough stormwater drainage system. Each pre-cast concrete catch basin was covered with a convex grate to minimize clogging. A vegetated drainage swale was constructed between the building and the railroad to facilitate drainage around the building. Roof drainage is collected in scuppers and conveyed by downspouts to pre-cast concrete splash blocks and to the surface.

3.3.2.13 Potable Water Service

A potable water service line was installed for the GWTF to facilitate wash down and maintenance of the equipment. A 1-inch copper water line was connected to the 10-inch Borough service main located on the opposite side of Jackson Avenue. Within the GWTF, the line is equipped with a flow meter and backflow preventer prior to being reduced to a ¾-inch line for a hose connection. The hose station consists of a hose reel and nozzle holder.

3.3.2.14 Site Restoration

An 8-foot high chain link fence with privacy screens was installed around the GAC units and valve tree. Two pedestrian gates and one 12-foot wide vehicular gate was provided for access.

Restoration of the concrete sidewalk and curb along most of the majority of Jackson Avenue in front of the GWTF was required, and concrete apron/depressed curb were installed at each of the two access roads. A thickened sidewalk consisting of a 10-inch concrete slab on top of 6-inches of dense graded aggregate (DGA) base course was constructed because it is likely that vehicles used for change-out of the carbon will be required to park on the sidewalk during change-out due to space constraints.

Access roads and parking areas are shown on **Figure 2-5** and as-built drawing Sheet C-3. The access roads and parking areas consisted of 6-inches of crushed stone, which was placed on top of a layer geotextile fabric. The remaining disturbed area was covered with 6 inches of topsoil and seeded.

Bollards were placed around the catch basins, electrical utility pole, and GWTF double doors for protection.

The completed facility is shown on **Photo 10**.

3.3.3 Groundwater Treatment System

The GWTF treatment train consists of a bag filter, low-profile air-stripper and two vapor phase GAC units. An in-line heater was included on the air-stripper off-gas line to improve the efficiency of the carbon. A schematic line diagram of the treatment train is shown on **Figure 2-6**. The facility process and instrumentation diagrams and equipment/piping layout are shown as-built drawings Sheets PR-01 though PR-05 and M-01 through M-02, respectively. GWTF influent CVOC concentrations were estimated based on groundwater monitoring well data collected during the PDI groundwater monitoring events. The treatment facility was designed to treat total VOC concentrations of approximately 5,100 ppb at average and max flow rates of 155 gpm and 210 gpm, respectively.

3.3.3.1 Bag Filter

A bag filter was installed upstream of the air-stripper to remove particles that could potentially foul the air-stripper and to reduce the particulates to levels below the permitted discharge limits. One carbon steel Hayward MAXILINE™ MBF HE Series bag filter housing model number MBF-0302-AB10-030A-UT-11HE was installed. The vessel is rated for 230 gpm and 150 pounds per square inch (psi) and houses three filter bags. The filter bags are 25 micron Eaton Sentinental filter bags, model number PO-25-P02E-WW-30.

3.3.3.2 Air Stripper

The air-stripping system consists of stainless steel Carbonair STAT 400 low profile air stripper with 5 trays and a 40-HP, 460 volt (V), 3-phase New York Blower model #2610A (designed for 2,100 cfm at 55 inches water column (wc)) piped in an induced draft configuration. The blower placed after the air stripper to take advantage of the increase in air temperature to decrease relative humidity prior to vapor phase GAC off-gas treatment, which improves the carbon efficiency. The air-stripper has a capacity of 210 gpm at the design concentrations as described in Section 3.3.3.

The air-stripper is equipped with a high efficiency demister, an external sump gauge to allow visual observation of water level, mechanical flow control devices which regulate water volume in each tray to prevent air short circuiting, and access ports to facilitate cleaning. A silencer was installed on the blower outlet for sound dampening. The air stripper and blower were bolted directly to the equipment pad in the GWTF building, which was set at the 100 year flood elevation of 516.00 feet amsl. Air stripper tray installation is shown in **Photo 11**.

The following instrumentation was also provided by the air-stripper vendor for operation of the equipment:

- A high level alarm switch for the air-stripper sump
- Sump pressure gauge
- Blower high/low vacuum switch and gauge
- Air flow meter sensor and gauge

Although the induced draft configuration of the blower will provide a temperature increase for the air-stripper off-gas, it was determined that additional heating may be required to keep the relative humidity below the target goal of 50 percent through the GAC piping and vessels because significant heat loss is expected during the winter months (the GAC vessels and majority of the GAC piping is located outside). An in-line duct heater was therefore installed after the blower prior to the discharge air piping existing the building. The 18-kW, 460 V, 3-phase heater, which is capable of increasing the air temperature by 25 degrees F, has a local control panel, which has been integrated with the facility’s main control panel.

The 3-inch groundwater influent pipe is enlarged to 6 inches prior to entering the air-stripper. The air-stripper effluent collects in the 500 gallon air-stripper sump and exists through and 8-inch discharge pipe, which is then reduced to the 6-inch Schedule 80 PVC effluent line. The effluent line includes a flow meter for monitoring the quantity of treated water; a check valve to prevent any water from the Borough's storm draining system from entering the GWTF process equipment, and a piping configuration of an upside-down "U" prior to exiting the building in order to keep the pipe full at the flow meter.

The 8-inch Schedule 80 PVC air-stripper air intake line penetrates the east side of the building. The pipe entrance has a downturned 90 degree elbow with bird screen to prevent rain and animals from entering the pipe. The 18-inch diameter air-stripper exhaust is reduced to a 10-inch Schedule 80 PVC pipe that is connected to the blower inlet. The 10-inch blower discharge is enlarged to a 12-inch Schedule 80 PVC pipe after the silencer and continues to the in-line duct heater prior to exiting the south wall of the building when the exhaust pipe connects to the outdoor GAC valve tree, which is described below.

3.3.3.3 Vapor Treatment

The vapor treatment system consists of two 3,000 pounds GAC units and associated GAC valve tree with piping and discharge stack. The GAC units are located outside on an equipment pad located on the south side of the GWTF building. As described in Section 2.6.3.3. The height of the pad at the GAC units was set at the 100-year flood elevation of 516.00 feet amsl.

Each GAC unit is constructed of fiberglass-reinforced plastic (FRP) with a 1-inch layer of insulation (R value of 5) with an overlay FRP wrap and final gel coat exterior wrap, which has been painted grey. Each vessel is approximately 7.5 feet in diameter and approximately 10 feet in height. Each GAC unit includes a 24-inch manway, 12-inch influent and effluent flanges, two lifting lugs, a 1 ½-inch condensate drain, and FRP skirt with anchors. A valve tree was constructed so that each unit can be operated in a lag or lead configuration without having to detach any of the piping. The tree consists of Schedule 80 PVC piping with associated butterfly valves, except for the 12-inch material flexible hose that connects the GAC effluent flanges to the valve tree. The vapor treatment system effluent is discharged through an approximately 28-feet tall, 12-inch diameter PVC discharge stack, which is equipped with a rain collar and bird screen.

Half-inch condensate drains were also installed at the GAC valve tree and stack. The condensate drains from the GAC units and GAC tree piping and stack combine into one line and are routed to the GWTF sump. Heat tracing and insulation has been installed on the drain lines to prevent standing water from freezing during the winter months. All exterior piping was painted for ultra-violet protection (UV) protection.

As described in Section 3.3.2.14, a chain-link fence was installed around the GAC equipment pad to prevent unauthorized access and a gravel road was provided for access to the GAC units.

3.3.3.4 GWTF Sump

The GWTF floor containment area is sloped towards the trench floor drain, which is located along the west side the of GWTF portion of the building. The floor trench drains to the building sump (2 feet by 2 feet by 2.5 feet deep), which is located at the southwest corner of the room. A sump pump (Zoeller Pump Co. sump pump model N163) conveys water that accumulates in the sump for treatment by the groundwater treatment system. The line from the sump ties into the system just upgradient of the bag filter and is equipped with a check valve and basket strainer. The sump pump is control by level control floats that are located in the sump.

3.3.3.5 Process Control System

The ground water treatment facility is controlled by a PLC based control system. The control logic for the entire facility is programmed in the PLC system, which is located inside the GWTF building. The PLC system monitors and control the equipment located inside the building including the air stripper, blower, building sump pump, in-line duct heater as well as the equipment located in the field such as the extraction well pumps. The PLC, auto-dialer system, electronic instrumentation and controls, and mechanical equipment are used to: 1) allow for automated process operation and control, 2) protect process equipment from damage, and 3) prevent unforeseen hazardous and undesirable conditions associated with treatment system operations.

The groundwater treatment facility contains a main control, which consists of the following:

- A flat-screen display Operator Interface Terminal (OIT) consisting of a mounted touch screen supervisory control and data acquisition (SCADA) workstation. SCADA workstation runs Human Machine Interface (HMI) software which includes graphical screens allowing the operator to view and control the process.
- A PLC that records data/information from process instrumentation (e.g., instantaneous rate and totalized flow) and equipment, monitors the operational status of process equipment (e.g., on/off), performs limited changes in process operations (e.g., pumps on/off, system shutdown), and initiates communications (internal/external) to convey operational status information within the programmed constraints. The as-built Process and Instrumentation Diagram (P&ID) Sheets PR-01 though PR-05, included in **Appendix K**.
- An auto-dialer that executes PLC-initiated communications via annunciator and phone
- Capability to allow for remote access to the treatment facility control system via phone or computer system using landline telephone and broadband cellular network.
- Uninterruptible Power Supply (UPS) to provide power to the control panel during a power outage

A remote input/output (I/O) panel for the extraction wells is located at the park near the intersection of Maple Avenue and Mott Place. The remote I/O panel is described in Section 3.3.4.4.

The PLC system continuously monitors and controls the equipment and generates alarms if any process variable gets outside the operator entered limits or if any equipment malfunctions. The remote notification of alarms is done by the auto-dialer. Operator can also dial in using a phone to the auto-dialer and can hear the current readings of few programmed process variables. The facility alarms generally consist of the following:

- Low/high water level, pump variable frequency drive (VFD) fault or overload condition, pump low flow condition at the extraction wells

- High/low pressure/vacuum, high/low flow, and high temperature for the facility piping
- High differential pressure across the bag filter
- High water level condition in the air-stripper sump, building sump, and the Borough discharge manhole
- Fault conditions for the air-stripper blower and in-line duct heater
- Fire and security alarms

In addition, the following instrumentation/interlocks were included to protect equipment and prevent discharge of untreated water:

- Extraction wells pumps and sump pump are unable to run if blower is not running for both auto and hand mode (to prevent discharge of untreated water)
- Blower continues to run for 5 minutes after all extraction well pumps and sump pump are shut down (to prevent discharge of untreated water)
- Blower shuts down if all extraction well pumps and sump pump are not running (to prevent freezing in air stripper)
- A 2 to 5 minute delay after blower shutdown to allow the blower to reach a complete stop before it can be re-started (to prevent damage to blower)
- Installation of a fail-safe valve on the influent line that will automatically close upon a power outage to prevent all the water in the trench influent piping system from entering the GWTF which is located at the lowest point in the system

3.3.4 Trench Construction

The extraction wells are situated in locations removed from the GWTF, connected by a force main which was installed in a trench through the Borough streets, including Maple Avenue, Mott Place, Halsey Avenue, and Jackson Avenue. While trenching on these narrow residential streets, CAPE coordinated closely with Rockaway Borough Police Department, Borough of Rockaway Department of Public Works (DPW), utilities, and local residents to ensure that trenching work was conducted safely with minimal impact to the community. A contingency plan was in place to de-energize electrical service to residences and businesses along the trench route in order to maintain clearance between energized overhead wires and excavation equipment. The trench was constructed without the need to de-energize any electrical services.

3.3.4.1 Piping and Conduit

A force main combining flows from wells EW-5A, EW-8, EW-9, EW-6, and EW-10 conveys groundwater into the GWTF building through a combined force main header for treatment and discharge. The force main construction is shown in **Photos 12, 13, 14, and 15** at the end of this section. The force main is made of double-contained HDPE piping with leak detection to prevent contamination should a leak in the piping occur. Leaks will be detected by manually opening valves on the outer containment pipe that are located in the extraction well vaults and at the GWTF. The valves will be checked for leaks on a routine basis as part of the facility inspections. The pipe was laid in a trench with 3.5 feet of minimum cover, with 10 inches of minimum space on either side. All excavated trench material was transported to the lay-down area at the Gee property shown in **Figure 3-2e**, sampled, and disposed of as non-hazardous waste at the appropriate facility discussed in Section 3.3.7. The dual wall HDPE pipe was wrapped with tape with the inscription “non-potable water” to protect against cross connection of the force mains to the water supply. The trench was then filled with common fill from Weldon Quarry Company in Hopatcong, NJ. Testing results of backfill are provided in **Appendix J**. Depending on the trench location, either pavement or grass was restored on the surface; see drawing G-2 of the trench package drawings for location details.

The diameter of piping was designed to accommodate the expected range of flows, while maintaining a velocity of approximately 2 to 10 feet per second (fps). Thus, the force main starts at EW-5A with a 2 inch diameter (inner piping), remains the same to and from EW-8 and EW-9, increases in diameter to 3 inches after EW-6 to accommodate for higher flow, and increases to 4 inches in diameter after EW-10 and enters the GWTF. The containment piping consistently remains double the diameter of the inner piping. The HDPE pipe meets a 125 psi pressure rating, and has a dimension ratio (DR) of 17. Minimum wall thickness for the 2, 3, 4, 6, and 8 inch pipes are 0.140, 0.206, 0.265, 0.390, and 0.507 inches, respectively. All fittings and wyes were fabricated by Lee Supply Co., Inc of Charleroi, PA. For all fittings and wyes, the DR had to be increased to match pipe strength of connecting pipes. The dual contained wyes are all rated at 100 psi. The DR for the 2 x 4, 3 x 6, and 4 x 8 inch dual contained wyes is DR9 x DR17 for all wye sizes. Approximately 2,200 linear feet (LF) of trench was constructed for the force main and conduits.

3.3.4.2 Cleanouts

A cleanout manhole is located along the force main to the west of the building before the main enters the building. The cleanout allows for any debris or sediments that settle in the force main piping to be removed to allow constant steady flow into the treatment system. The cleanout is made of concrete with steel reinforcement, and provides a 3 foot diameter opening. At the surface there is a frame and heavy-duty steel cover to seal the opening of the cleanout. The cover is supported by a frame bordered by a 3.9 by 3.9 foot pad, and a concrete pad poured in around the cover.

3.3.4.3 Handholes

Electrical hand holes are installed throughout the length of the power and control circuit conduit raceway installation at the Rockaway remediation site. The handholes serve two major components in the design as required by the National Electric Code (NEC). First the handholes serve as a cable pulling point for the long distances covered. Handholes were installed at approximately every two hundred to two hundred and fifty feet or when the number of bends in any one continuous length of raceway exceeded 270 degrees. This is done to reduce the pulling tension on the individual conductors. The Rockaway design had several extraction wells that branched out from the central raceway path, the handholes provided a convenient method to separate the wiring associated with those wells. All the handholes utilized on the project where precast and sized based on conductor count.

3.3.4.4 Remote I/O Panel

Due to the significant distance between the extraction wells and the GWTF, a remote I/O panel (RIO) was required. The RIO panel, which is located behind the concession stand in Memorial Park, acts as an extension of hardwired I/O interface. All the signals from the groundwater extraction well pumps and sensors are connected to the RIO panel. RIO panel is connected to the treatment building PLC panel via fiber optic cable. Each ground water extension well contains a submersible type level sensor. Each extraction well pump is controlled by the VFD located inside the RIO panel.

3.3.4.5 Trench Restoration

Common fill was used to backfill the trenches. The fill was from the Weldon Quarry Company in Hopatcong, NJ, and passed chemical and geotechnical testing. Washed sand was placed around conduits. Washed sand from three vendors was tested for chemical and geotechnical parameters, and Sahara Sand of Englewood, NJ was chosen as it had the most desirable results. Traceable red marker tape from Terra Tape of Houston, TX was put in place around the conduit and is able to be detected by a metal detector. Surface restoration above the trench consisted of pavement in paved areas and grass in the park area.

3.3.4.6 Vaults

Well vaults for EW-5A, EW-6, EW-8, EW-9, and EW-10 are precast concrete, flush mount, with a 10 inch thick wall and 12 inch thick roof. The inner dimensions for the precast concrete vaults are 36 x 72 x 64 inches, except for EW-6 which has inner dimensions of 48 x 72 x 58 inches. Vaults were supplied by Precast Manufacturing Co., LLC of Phillipsburg, NJ. Heavy duty gray cast iron manhole frames and non penetrating watertight flow-seals supplied by Campbell Foundry Company of Harrison, NJ cover the vaults. The manhole cover is 25.75 inches in diameter and 1.375 inches thick. The manhole cover frame ranges from 26 to 39 inches in outer diameter, and is raised 8 inches high.

Extraction wells EW-6, EW-9, and EW-10 are located outside the vaults because there was not enough space for the well vault due to existing utilities. There is double wall HDPE pipe between the well and the vault in these instances.

The well vaults contain the pitless adapter at the top of the well head, check valve, flow meter, pressure gauge, gate valve, and drain with ball valve on the containment piping. All exposed piping is heat-traced and insulated.

Photos 12, 13, 14, and 15 show the trench construction.

3.3.5 GW-1 Supply well

GW-1 supply well is one of three water supply wells owned by the Borough of Rockaway DPW. A photo of GW-1 is included as **Photo 16** at the end of this section. The well and building were constructed in 1922. The well is 53 feet deep and has a diameter of 38 inches with a 20-inch inner liner. The well was equipped with a vertical turbine pump (VTP) set at 49 ft bgs. The pump typically produces approximately 521 gpm at 158 feet total dynamic head with a pumping water level of 41.4 ft bgs. The pump is a Layne Model 10RKHC-4 equipped with a single-speed 460V, 3-phase, 1750 revolutions per minute (rpm), 30-HP motor. Well GW-1 feeds the Rockaway Borough Municipal

Drinking Water Plant (MDWP). The MDWP treats the water to remove environmental contaminants via air stripping and activated carbon prior to chlorine disinfection and distribution. The MDWP is fed by three active supply wells: GW-1, GW-5, and GW-6. Only two wells are kept online at any given time. Well GW-6 is online continuously, and GW-1 and GW-5 are online in alternating 24-hour periods. When online, the well pumps are controlled by the water level in the DPW's distribution tanks. When the water level in these tanks falls below the LOW setpoint, the well pumps automatically come on, and when the water level in the tanks reaches the HIGH setpoint, the well pumps automatically turn off.

Section 3.3.2.2 describes the GW-1 bypass configuration, installed by CAPE to keep the well in service during construction. The existing VTP was removed following building demolition, and re-furbished off-site by A.C. Schultes of Woodbury Heights, NJ. Well GW-1 is housed in a new well house similar in size to the original well house. The floor of the new well house was constructed at the Flood Hazard Elevation (516 amsl). The modifications to the well head include extending the inner casing and raising the pump pad and sole plate to Elevation 517 feet amsl, which is one foot above the Flood Hazard Elevation. Well head electrical and control appurtenances were also modified and installed above Elevation 517 feet amsl in the new building. All electrical and mechanical equipment was installed at least one foot above the Flood Hazard Elevation. The new well house is a separate room attached to the GWTF. The wall between the GWTF and well house rooms is solid, without penetrations, except for a 1-inch diameter floor drain leading to the sump in the GWTF, which is equipped with a check valve. The only access to the well house is through a separate, dedicated man door leading directly into the well house. The well house and GWTF have separate control systems, alarm systems, and potable water supplies.

The re-furbished VTP was installed in GW-1, and the system was disinfected, tested, and put back in service on November 14, 2011. GW-1 bacteriological testing results are included as **Appendix L**. It is equipped with an air release valve, flow meter, and potable water feed for seal water. The discharge piping is 6-inch cement lined ductile iron. It exits the well house on the south side of the building and continues to the municipal drinking water treatment plant. Items reused from the existing pump are the pump control panel, flow switch, flow switch transmitter/controller, wireless transmitter for pump phase monitoring with power supply, and pump motor phase monitor. New items installed for the GW-1 bypass pump are a service entrance/meter, breaker panel, main disconnect, pump motor starter panel, control panel components, pump motor starter (with soft start), air/vacuum release valve, and check valve. The soft start pump motor starter installed during bypass was retained in the permanent system. This feature eliminates motor over-fluxing for the VFD and allows the motor to operate more efficiently when under-loaded.

All work on the GW-1 well house was conducted in accordance with the construction permit issued by NJDEP Division of Water Supply, Bureau of Water Systems and Well Permitting, which is found in **Appendix B**.

3.3.6 Gee Property (FHA Offset Area)

As discussed in prior sections, the decision was made to construct the GWTF at Rockaway Borough Lot 18, Block 14 (122 Jackson Avenue), which is located in the flood fringe of the Rockaway River. State of

New Jersey FHA regulation N.J.A.C. 7:13-10.4 sets forth the specific design and construction standards that apply to any regulated activity in a flood fringe. Specifically, this rule addresses the zero-net fill requirement. When material is placed aboveground in a flood fringe, an equal compensatory volume must be created.

The draft design, upon which the offset volume was based, contained the following site features that displace flood storage volume; building containing the GWTF and GW-1, the existing Rockaway Borough supply well; the outdoor concrete equipment pads for the vapor phase GAC units and associated piping; and an outdoor concrete equipment pad for the electrical transformer. Flood storage was created by demolition of the existing well house (building foundation volume only), and by site re-grading. A summary of the flood storage volume calculations based on the draft design is included in Table 3-4.

Table 3-5
Cut and Fill Volumes

Feature	**Volume Displaced "Fill" (CY)**
Well House (GW-1)	13
Groundwater Treatment Facility	35
GAC Equipment Pad	13
GAC Piping Pad	4
Transformer Pad	5
Total	**70**

Feature	**Volume Gained "Cut" (CY)**
Demolition of Existing Well House (GW-1)	9
Site Grading	30
Total	**39**

The site re-grading at 122 Jackson Avenue was designed to minimize the amount of fill. However, due to the small size of the site, the net fill volume was approximately 40 CY. Since zero net fill was not attainable at the building site, an offsite compensation area was sought to meet the requirements.

The project team screened five sites owned by Rockaway Borough to use as the off-site compensation area. The Gee Property, Rockaway Borough Block 40, Lot 76, located at the intersection of Nicholson Drive and Mannino Drive, was the only property that met all offsite land compensation requirements defined by N.J.A.C. 7:13-10.4(p). The location of the Gee Property is shown on **Figure 1-1** and a site plan for this property is included as **Figure 3-3**. There is a MOA between the Borough of Rockaway, Morris County, New Jersey and the EPA which allow the EPA to utilize a portion of the Gee property as the offsite compensation area to meet the NJDEP's zero net-fill requirement.

During utility installation at 122 Jackson Avenue it was determined that a pole-mounted transformer would be used, precluding the need for a transformer pad, thereby reducing the fill to 65 CY. However, for the off-site compensation area design, an offset volume of 80 CY was used to provide certainty that it would be adequate in case other changes were required during construction which would add more fill.

The Gee Property was also used by CAPE during construction for storage of various construction-related materials, including pre-cast materials, pipe, stone, and sand backfill materials. The location of the compensation area within the Gee Property was detached from the part of the property used for storage.

CAPE utilized a landscape subcontractor, Enviroscapes Inc., of Monmouth Junction, NJ to conduct the off-site compensation area construction. As-built drawings for the Gee Property are included in **Appendix K**. **Photo 17** shows the construction at the Gee Property.

Prior to beginning work, CAPE's land surveyor subcontractor, LAN Associates, conducted a survey of the cut area to determine pre-work grades, and set grade stakes for the workers to determine the cut. Soil erosion controls were established on the perimeter of the cut area. CAPE's landscape subcontractor, Enviroscapes, Inc., contacted the NJ One-Call system for underground utility mark-out prior to mobilization.

Enviroscapes, Inc. used a small track-mounted backhoe with a bulldozer blade attachment to excavate to the design grades. An additional 6-inches of excavation was conducted, and subsequently backfilled with topsoil. Excavated material was staged on-site at the Gee Property prior to sampling and off-site disposal. A post-excavation grade survey was conducted to confirm that the proper amount of soil had been removed. Following sampling, the excavated material was transported off-site by Maddox Materials, Spotswood, NJ and disposed at Soil Safe, Inc. in Logan Township, NJ. Following backfill with topsoil, the excavation area was hydroseeded and covered with straw.

3.3.7 Transportation and Disposal

Drill cuttings generated during the 2007 well installation (EW-5, EW-7, EW-7A, and EW-6), were staged in roll-off containers in the trailer compound in the Friendship Field lot. The building demolition debris, asphalt and concrete pavement, drill cuttings generated during the 2011 well installation (EW-5A, EW-8, EW-9, and EW-10), and trench excavation spoils were transported to the temporary lay-down area at the Gee Property. The material was placed on the asphalt and covered with plastic in accordance with the SESC plan until a sufficient quantity was generated for disposal. Asbestos containing flashing, building caulk, and window glazing was removed from GW-1 on November 24, 2010 prior to demolition of the building. ACM was contained in drums and disposed of at G.R.O.W.S. Landfill. Other transportation and disposal incidental to the construction included spent carbon, and light metal, which was recycled. Transportation and disposal of all construction generated material is summarized in **Table 3-6**. Waste disposal characterization data is located in **Appendix M**.

Table 3-6
Waste Disposal Summary

Source	Quantity	Transporter	Permit No.	Facility Type	Facility
Non Friable ACM (122 Jackson Ave.)	4 yards	Abatetech, Inc. P.O. Box 25 Lumberton, NJ 08048	PADEP 101680	Subtitle D	G.R.O.W.S North Landfill 100 New Ford Mill Road Morrisville, PA 19067
Spent Carbon (Temporary Treatment System)	8000 pounds	Clean Venture Inc. / Cycle Chem Inc. 217 South First Street Elizabeth, NJ 07206	PADEP 100148	Subtitle D	G.R.O.W.S. INC 1513 Bordentown Road Morrisville, PA 19067
Building Demolition Debris	112.40 tons	Maddox Materials, LLC 323 Main Street St Spotswood, NJ 08884	CBG020002	Class B Recycling	Pure Soil Technologies 655 South Hope Chapel Road Jackson, NJ 08527
Sidewalk and Curb Debris	136.91 tons	Maddox Materials, LLC 323 Main Street Spotswood, NJ 08884	CBG020002	Class B Recycling	Pure Soil Technologies 655 South Hope Chapel Road Jackson, NJ 08527
Asphalt Debris	651 tons	Maddox Materials, LLC 323 Main Street Spotswood, NJ 08884	CBG110002	Class B Recycling	Weldon Materials 181 State Highway 181 Lake Hopatcong, NJ 07849
2007 Drill Spoils (EW-5, EW-6, EW-7, EW-7A)	20.12 tons	Allstate Power Vac 92B Hazelwood Ave Rahway NJ 07065	PADEP 100148	Subtitle D	G.R.O.W.S. INC 1513 Bordentown Road Morrisville PA 19067
2007 Drill Spoils Cont. (EW-5, EW-6, EW-7, EW-7A)	26.84 tons	Allstate Power Vac 92B Hazelwood Ave Rahway, NJ 07065	PADEP 101494	Subtitle D	T.R.R.F. 200 Bordentown Road Tullytown, PA 19007
2011 Drill, Building, and Trench Spoils	4339.39 tons	Rainbow Transport 1476 Rt. 46 Ledgewood, NJ 07852	CBG080003	Class B Recycling	Soil Safe Inc.-Bridgeport 378 Route 130 Logan Township, NJ 08085
Gee Property Excavation Spoils/Chipped Tree Debris	271.86 tons	Rainbow Transport 1476 Rt. 46 Ledgewood, NJ 07852	CBG080003	Class B Recycling	Soil Safe Inc -Bridgeport 378 Route 130 Logan Township, NJ 08085
Light Metal	1.28 tons	Nacierma Industries 211 - 217 West 5th Ave Bayonne, New Jersey 07002	TRP09001	Class A Recycling	Evergreen Recycling Solutions LLC 110 Evergreen Ave Newark, NJ 07114

3.3.8 Demobilization

CAPE demobilized all items and temporary facilities from the site in December of 2011.

3.4 Green Remediation

Efforts were made to decrease the environmental footprint of construction activities at the site. 100 percent renewable energy, consisting of 50 percent wind, one percent solar, and 49 percent low-impact hydro energy was purchased through local utility provider, JCP&L, for electrical service used at the Friendship Field lay-down yard and at the CAPE and USACE field offices, and is being used at the GWTF. Approximately 50,000 kilowatt hours (kWHs) of renewable energy were consumed during the construction activities. In addition, the electricity at the Pine Street Commons field offices utilized 60 percent solar energy. Energy usage for the Pine Street Commons field offices is not available.

Also, when possible, waste materials were recycled including debris from the demolition of the existing well house, sidewalk, curb, and asphalt; drilling and trenching spoils; Gee Property excavation spoils; and light metals from the GW-1 well house demolition. Approximately 5,500 tons of waste material generated during construction was recycled. A green remediation summary providing energy providers and recycling facilities is included in **Table 3-7**.

Photo 1 – Drill Rig Installing Well EW-5A

Photo 2 – EW-10 Development

Photo 3 – GW-1 well house demolition

Photo 4 – Building foundation preparation

Photo 5 – Building Foundation Formwork

Photo 6 – Building Stem Wall and Slab Pour

Photo 7 – First Masonry Course

Photo 8 – Masonry Construction Progress – Bond Beam

Photo 9 – Pre-cast Hollow-Core Roof Panels Being Lifted into Place

Photo 10 – Groundwater Treatment Facility Exterior Site Restoration

Photo 11 – Air Stripper Assembly

Photo 12 – Force Main Welding Prior to Installation

Photo 13 – Trench Construction

Photo 14 – Trench Construction – EW-10 Connection to Vault

Photo 15 – Trench Construction at GWTF Property

Photo 16 – Well GW-1

Photo 17 – Gee Property Construction (Off-site Compensation Area)

Section 4
Chronology of Events

The following table lists major events that took place during the OU2 RA.

Date	Event
September 30, 1991	OU2 ROD signed by EPA
October 26, 1994	Consent Decree between EPA and Thiokol
July 31, 1996	Preliminary (35%) Design Report and Technical Memorandum Submitted
December 2002	Intermediate (65%) Design Submitted
September 28, 2005	Pre-final (95%) Design Submitted
February 2006	Final (100%) Design Submitted
May 25, 2006	Contract Award to CAPE Environmental Management, Inc.
June 29, 2006	Pre-work (Kick-off) Meeting
August 15, 2006	Permit Coordination Meeting
May - October 2007	Extraction well installation (EW-5, EW-6, and EW-7)
December 19, 2007	Combined building design concept presented to NJDEP
February 13, 2008	ARAR waiver letter issued for 122 Jackson Ave
February 15, 2008	Force main design submitted
June 2008	Temporary construction shutdown
April 2009 - May 2010	Additional Pre-design Investigation of EM/WS Plume
June 28, 2010	Re-start Kick-off meeting
September 16, 2010	Draft combined GW-1 and GWTS design submitted
October 22, 2010	Begin mobilization and site preparation
November 10, 2010 - March 4, 2011	GW-1 Pump house demolition and debris removal
November 22, 2010	Final combined GW-1 and GWTS design submitted
November 22, 2010 - October 27, 2011	Process Equipment procurement and installation
December 3, 2010	Force main design revision submitted
December 3, 2010 - November 23, 2011	GTS Building Construction
December 3, 2010 - March 30, 2011	Extraction well installation (EW-5A, EW-8, EW-9, and EW-10)
March 28 - August 11, 2011	Force main Installation
April 11 - 19, 2011	Baseline groundwater sampling
July 20 - November 23, 2011	Site restoration and demobilization
August 1 - September 1, 2011	Extraction well pump installation (EW-5A, EW-6, EW-8, EW-9, & EW-10)
September 16 - October 22, 2011	Flood storage area construction
September 21 - November 23, 2011	System startup and performance testing
On-going	Quarterly groundwater monitoring and reporting
On-going	Routine O&M, performance/compliance monitoring, and reporting

Section 5
Performance Standards and Construction Quality Assurance/Quality Control (QA/QC)

CAPE implemented a QC program that incorporated the requirements of the project specifications and the approved Contractor's site specific Contractor Quality Control Plan (CQCP). USACE NY District provided QA through the use of onsite personnel to monitor project performance.

5.1 Project QA/QC Organization

The RA was supported by both field and office personnel. CAPE onsite personnel consisted of the Site Superintendent, Contractor Quality Control Systems Manager (CQCSM), and Site Safety and Health Officer (SSHO). The overall project organizational chart is presented in **Figure 5-1**.

5.2 Construction QA/QC Implementation

This section describes the QA/QC procedures that were implemented during RA activities. The intent of the construction QA/QC was to ensure that all work was completed in accordance with the requirements of the Contract Documents. In addition, the QA/QC program requirements for RA construction were specified in the approved project plans (**Appendix A**).

The QA/QC activities performed during the RA construction included the following:

- Design documents prepared by CDM Smith were subject to its internal QA/QC procedures. A technical review committee (TRC) was convened to review the draft design documents. The TRC represented the various design disciplines required for the design preparation. Written comments were submitted and addressed by the design team, and review was documented with signed Technical/QA review forms. The final design drawings were signed and sealed by NJ-licensed engineers and architects.

- Technical submittals were reviewed by CDM Smith to verify conformance with the Contract Documents and industry standards, prior to submittal to USACE. CDM Smith review was documented with internal transmittal cover sheets, and cover letters for all technical submittals.

- Weekly progress meetings were conducted to address the H&S, project administration, work progress, observations, problems and conflicts, schedule, submittals, quality control, cost tracking, changes and substitutions, funding and payment status, community relations, and other business. The meeting agendas were prepared by CAPE, and draft minutes were distributed for comment by all participants, finalized and distributed by CAPE on a weekly basis.

- Contractor Quality Control (CQC) Reports were prepared daily to document daily site conditions, construction activities, inspections, testing results, and site-specific issues including site security.

- Field inspections and testing were performed to verify compliance with the RD requirements, approved RA construction submittals, and approved project plans. Inspections included observations of all construction materials and workmanship. All inspection and testing results were evaluated to determine areas that required reworking and/or repair. Deficiencies were documented by the USACE Project Engineer.

- A three-phase quality check was conducted for each definable feature of the work. The checks include preparatory, initial, and follow-up inspections. The preparatory inspection was performed after all required plans, documents, and materials were approved and copies were at the work site. The initial inspection was conducted after the completion of a representative sample of the work. The follow-up inspection consisted of daily quality control activities to ensure compliance with contract requirements until the completion of a particular definable feature of work.

5.2.1 Review of Technical Submittals

CDM Smith was the designer of record and reviewed and approved all technical submittals. The submittal and review process allows the monitoring and control of the quality of construction before construction is initiated. The submittals generally included project plans, shop drawings, material samples, material test results, chemical data sample results, manufacturer's literature, engineering calculations, engineering drawings, operating instructions, and QC test procedures and results.

5.2.2 Field Inspection and Testing of Materials, Equipment and Installation

Resident engineering was performed by USACE and included routine inspections and observations of all construction activities and testing procedures. The deficiencies identified during routine inspections and corrective actions taken were noted on the Deficiency Tracking Log (**Appendix N**). Field density, rebar, and concrete inspection reports are included as **Appendix I**.

5.2.3 Documentation

Both the USACE and CAPE maintained accurate and comprehensive records of RA construction activities in accordance with the RD requirements, approved RA construction submittals, and approved project plans. A summary of the record documents is provided below:

- CQC Reports – Daily CQC reports were completed by CAPE to document daily site conditions, QC activities, construction activities, labor and equipment hours, and accident reporting and submitted to USACE. The reports are included in **Appendix O**.

- QA Reports – Daily QA Reports were completed by USACE NY District to document site conditions and construction/QA activities.

- Project Progress Photographs – Progress of site activities was photographically documented on a routine basis. Progress photographs were taken during the 2007 well installation in April, May, and August – October 2007, and every month following re-start of the project from December 2010 through December 2011. Progress photographs were submitted to USACE on a monthly basis. A complete set of progress photographs is included in **Appendix C1**.

- Weekly Progress Meeting Minutes – Weekly progress meeting minutes were prepared as a record of the construction progress to document the RA activities as discussed in Section 5.2. The meeting minutes are included in **Appendix P**.

- As-built drawings – Record As-built drawings for all site activities including site preparation, building construction, groundwater treatment system P&ID, excavation, trenching, and site restoration were prepared by CAPE. The As-built Drawings are included as **Appendix K**.

5.2.4 Contractor Change Requests

There were two contractor change requests (CCRs) during the RA period. CCR-001 requested additional funding to prepare necessary permits. CCR-002 requested additional funding to remove a gravity wall that was unexpectedly encountered under the well house slab during demolition. CCRs can be found in **Appendix Q**.

Section 6
Inspection and Certification

Baseline groundwater monitoring, system startup testing, and a final inspection were performed to ensure that all work was performed to the satisfaction of the EPA and USACE and in accordance with the RD requirements, approved construction submittals, and approved project plans.

6.1 Baseline Groundwater Monitoring

Baseline groundwater sampling was performed by CDM Smith between April 11 and April 19, 2011. Samples were collected from 47 monitoring wells, plus 4 new extraction wells installed by CAPE in 2011. The samples were analyzed for Target Compound List (TCL) VOCs. In accordance with the CDM Smith's July 3, 2007 Quality Assurance Project Plan (QAPP) Addendum and the Field Change Request (FCR) dated 4/1/11, the wells were purged and sampled using low-flow techniques. The purpose of the sampling was to establish a baseline for groundwater conditions prior to initiating treatment system startup.

Baseline VOC sample results are summarized in **Table 6-1**. **Table 6-1** also includes the groundwater remediation goals, which are based on N.J.A.C. 7:10 Safe Drinking Water Act MCL for State-Regulated VOCs. The sample results and PCE iso-concentration contours as compared to previous sampling event in 2009 and 2010 are shown on **Figure 6-1.**

VOC contaminant concentrations consist primarily of PCE, which is the key indicator parameter for the site, with the maximum concentrations observed at source area monitoring well MW-1A at 170,000 ppb. Concentrations decrease as the plume moves downgradient in a northeasterly direction with PCE sample result of 1,300 ppb at PZ-7, 560 ppb at PZ-10A, 250 ppb at PZ-11B, and 2.6 ppb at RBW-15. TCE is present at lower concentrations and exceeded the TCE remediation goal in 12 wells. Other than the maximum TCE concentrations observed at 130 ppb in MW-1A, the maximum concentration seen in all other wells was 18 ppb.

PCE concentrations have increased in several wells since the 2009 and 2010 sampling events. At the source area, MW-1A increased from 16,000 to 170,000 ppb. Significant increases were observed in the central portion of the plume, with PCE concentrations increasing from 250 to 810 ppb at PZ-6, from 160 to 1,000 at RBW-11, and from 374 to 560 ppb at PZ-10A. This indicates that the highly contaminated portions of the plume are moving downgradient and appear to be spreading outward in a side-gradient direction in both the north and south direction. A detailed summary of the ITP activities is provided in the ITP Report, which is included in **Appendix R**.

6.2 System Startup Testing

6.2.1 Groundwater Treatment System

Groundwater treatment system performance and compliance monitoring activities were performed during the functionality testing, 14-Day Operational Test and 48-Hour Performance Test. A summary of the GWTF startup testing activities are described below:

Functionality Testing

Functionality testing was performed from October 19, 2011, 9:10 hours to November 5, 2011, 19:20 hours. During the GWTF startup testing, each process component, I/O communication, sequence of alarms, and individual extraction well pumps were tested for functionality before the 14-Day Operational Test phase began. The functionality testing for the treatment process components were completed using clean potable water from a public hydrant adjacent to the site. For the Functionality testing of the extraction well pumps, contaminated water was pumped from five extraction wells (EW-5A, EW-6, EW-8, EW-9, and EW-10) and treated by the GWTF. Each extraction well was tested for one hour at three flow set points (minimum flow, 90 percent of the maximum flow, and the maximum flow for 20 minutes each).

14-Day Operational Testing

After each functionality test was conducted, and alarm sequences were simulated, tested and verified to work, the 14-day Operational Test commenced. The 14-Day Operational Test was performed from November 5, 2011, 19:20 hours to November 17, 2011, 16:00 hours. The following five flow scenarios were tested during the 14-Day Operational Test:

Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
EW-5A: 20 gpm	EW-5A: 20 gpm	EW-5A: 20 gpm	EW-5A: 50 gpm	EW-5A: 0 gpm
EW-8: 20 gpm	EW-8: 20 gpm	EW-8: 0 gpm	EW-8: 60 gpm	EW-8: 20 gpm
EW-9: 20 gpm	EW-9: 20 gpm	EW-9: 25 gpm	EW-9: 60 gpm	EW-9: 0 gpm
EW-6: 75 gpm	EW-6: 95 gpm	EW-6: 55 gpm	EW-6: 40 gpm	EW-6: 95 gpm
EW-10: 75 gpm	EW-10: 0 gpm	EW-10: 55 gpm	EW-10: 0 gpm	EW-10: 95 gpm
Total: 210 gpm	Total: 155 gpm	Total: 155 gpm	Total: 210 gpm	Total: 210 gpm

The primary purpose of the first six days of the 14-Day Operational Test was to test the system functionality. Scenario 1 was used during this time period. Subsequent flow scenarios were run for approximately 24 hours per scenario. Originally it was intended that two additional scenarios be performed based on the results of the first five scenarios. However, sufficient drawdown was achieved and minimal downtime occurred during operation of the five scenarios. The shortened duration of the 14-Day Operational Test (shortened to 12 days) was therefore accepted by the EPA and USACE.

48-Hour Performance Testing

The 48-Hour Performance test was performed from November 17, 2011, 16:04 hours to November 19, 2011, 16:04 hours. The 48-hour Performance test was immediately started upon the conclusion of the 14-Day Operational Test. It was determined that the following flow rates be used for the 48-Hour Performance Test for a total flow rate of 180 gpm:

- EW-5A: 20 gpm
- EW-8: 20 gpm
- EW-9: 20 gpm
- EW-6: 70 gpm
- EW-10: 50 gpm

Extraction wells were operated in flow control mode during both the 14-Day Operational Test and 48-Hour Performance Test.

Conclusions

A summary of the observations and recommendations for the groundwater treatment system testing activities is provided below:

- During the 14-Day Operational Test, the GWTF logged approximately 287 run-time hours and 1.1 hours of downtime, achieving a 99.6 percent on-line operating efficiency during this test. During this time, approximately 2,885,600 gallons were treated. No downtime occurred during the 48-Hour Performance Test.

- Performance samples were collected from the extraction wells and combined influent header during the startup activities. A summary of samples collected from the extraction wells is included in **Table 6-2**. For all five extraction wells, concentrations increased over the course of the startup testing.

- At the source area, the following drawdown was observed at nearby monitoring wells (during Scenario 1): 1.5 feet at both MW-1A and PZ-9B, 3 feet at PZ-9A, 2.5 feet at PZ-8, and 2.25 feet at RBW-1, indicating that capture of the plume is being achieved at this area. Considerable influence from pumping EW-5A and EW-8 was expected due to the lower hydraulic capacity of the aquifer in this area. At the downgradient portion of the plume near EW-6 and EW-10, approximately one foot of drawdown was observed at both PZ-10A and PZ-10B and 3 feet of drawdown was seen in PZ-5 during Scenario 1, indicating adequate plume capture in the vicinity of these wells during this scenario. Drawdown in the vicinity of PZ-7 could not be determined using the transducer data because the only nearby transducer, located in PZ-7, was only operating for a portion of the testing. Manual readings can be difficult to interpret because it is possible that water levels in this area can be impacted by approximately one foot by GW-5 pumping. Based on manual water level measurements, and accounting for a potential one-foot influence from GW-5, it is estimated that drawdown at PZ-7 was a minimum of 0.9 feet and as high as 2.3 feet.

- As described in the ITP report, it is recommended that the flow rate at EW-9 be increased to 30 gpm and the flow rate at EW-10 be decreased to 40 gpm to maintain the total pumping rate of 180 gpm. Increasing the flow rate at EW-9 will improve capture of the northerly side-gradient area of the plume, which has seen increases in PCE concentrations as compared to the 2009 and 2010 sampling events.

- It is recommended that a transducer be installed in one of the site monitoring wells to determine when GW-5 is pumping so manual water level readings can be adjusted as required.

- The five extraction wells will continue to operate in a flow control mode to maintain hydraulic control of the plume. Manual water levels and VOC samples will be collected quarterly from the site monitoring well network for evaluating plume capture. The extraction well flow rates should be revised as required based on monitoring results.

- The facility PCE concentration in the groundwater influent at the completion of the ITP was approximately 200 ppb, which equates to a PCE mass removal rate of approximately 0.5 pounds per day. A total of approximately 5 pounds of PCE mass was removed during the startup testing. A summary is provided in **Table 6-3**.

- All aqueous effluent sample results met the NJDPDES-DSW permit equivalent discharge criteria as shown on **Table 6-4**, with the exception of the effluent sample collected during the functionality testing of EW-6 on October 21, 2011, which showed a total organic carbon (TOC) result of 26 mg/L, exceeding discharge criteria of 20 mg/L. This exceedance was determined to be attributed to the use of polyvinyl bottles instead of amber bottles for collection of this sample.

- VOC mass removal rates of greater that 99 percent were achieved by the air stripper.

6.2.2 Off-gas Treatment System

A summary of the observations and recommendations for the off-gas treatment system is provided below:

- During the 14-Day Operational Test, the blower operated at a flow range of 2,050 to 2,200 cfm and operated at approximately 2,150 cfm during the 48-Hour Performance Test. This is consistent with the estimates determined during the RD.

- Temperature readings at the GAC units during the 14-Day Operational Test ranged from 78 to 88 degrees F. Adjustments should be made as necessary to maintain air stream at the GAC units at a temperature of approximately 75 to 80 degrees F, which is optimal for carbon efficiency.

- A summary of off-gas system influent and effluent samples is provided in **Table 6-5**. The off-gas system did not meet the VOC Air Pollution Control Permit equivalent discharge requirements for any effluent sample, primarily due to acetone and in some cases methyl ethyl ketone (MEK) and tetrahydrofuran (THF) concentrations. The system did not meet the Hazardous Air Pollutant (HAP) discharge requirement for one effluent sample primarily due to MEK. All effluent results for PCE were non-detect, and therefore met the PCE discharge requirement. The PCE removal rate in the GAC units was approximately 100 percent for all samples (assuming a value of zero for non-detect sample results).
- Because acetone, MEK, and THF parameters were not identified the groundwater influent, it is likely another source of contamination exists. Several recommendations have been provided in the ITP Report for identifying the contamination source. It is likely that the contamination is related to the PVC pipe cleaning solvent and glue, which contains significant amounts of these three parameters.
- Based on the non-detect effluent sample results for PCE, it can be assumed that contaminant breakthrough of the carbon has not occurred. Breakthrough will continue to be monitored during facility O&M.

6.3 Final Inspection

Representatives of USACE and CAPE conducted a Final Inspection on November 21, 2011. During the Final Inspection, punch lists documenting observed deficiencies were prepared. CAPE was required to correct all deficiencies. Punch list items identified during the Final Inspection are included as **Appendix S**. Upon correction of all deficiencies identified during the Final Inspection, all work was determined in compliance with preparatory and initial phase meetings, submittals, and RD requirements. No significant outstanding issues regarding the remedial construction were raised during the inspection, and the construction was determined as complete.

6.4 Health and Safety

43,810 man hours were worked over the course of 384 days without any lost time due to injury. As required by the Site Safety and Health Plan (SSHP), daily tailgate meetings were conducted. Special H&S considerations were discussed as they pertained to the daily activities. Weekly meetings were also held to review issues related to any new activities. A pre-construction safety conference was held on April 23, 2007. A copy of the H&S Phase-out report documenting procedures and any H&S issues, prepared by CAPE, is included in **Appendix T**.

General site workers were required to be trained and medically monitored for Hazardous Waste Operations and Emergency Response in accordance with 29 CFR 1919.120 including for excavation and trenching safety. All work was conducted in Level D personal protective equipment (PPE).

The contaminants of concern at the project site were PCE/ TCE, ACM, and lead-based paint (LBP). Confined space entry air monitoring was conducted for the various subsurface equipment vaults and associated treatment system piping and equipment manhole entry activities which were performed.

Minor amounts of ACM and LBP were identified during a pre-demolition survey within the Borough's existing 200-square-foot municipal well house (GW-1) building. The municipal pump house building ACM and LBP contamination was removed as part of a demolition phase of the project. All ACM and LBP materials were removed and disposed of as required by NJDEP by a state licensed abatement and demolition subcontractor.

Sampling indicated the PCE/TCE concentration levels in groundwater at the site were considerably of low risk in relation to the PCE/TCE presenting an airborne occupational health exposure hazard.PCE and TCE are VOCs. Monitoring for VOCs was accomplished using a photoionization detector (PID) equipped with a 10.6-electron volt (eV) lamp. The PID was calibrated prior to each use with a known concentration of isobutylene gas. VOC monitoring was conducted during drilling, well installation activities, treatment system installation and treatment system operation. The PID was used to monitor for the presence of VOCs at the source and in the personnel breathing zones during these work activities. No elevated concentration levels of VOCs were detected during project activities.

Confined space entry air monitoring was completed inside and along the perimeter of confined spaces onsite prior to personnel entry into the confined spaces. The air monitoring was conducted to determine air concentrations of oxygen, combustible gases and suspected toxic contaminants (carbon monoxide, hydrogen sulfide, VOCs). Continuous confined space monitoring was conducted while personnel were inside the confined space so action levels would not be exceeded during entry. Personnel were not allowed to enter a confined space with oxygen deficient or oxygen-enriched atmospheres (less than 19.5 percent or greater than 23.5 percent), potentially explosive atmospheres (greater than 10 percent of the lower explosive limit [LEL]), or potentially toxic atmospheres (carbon monoxide greater than 15 parts per million [ppm]), (hydrogen sulfide greater than 5 ppm), (VOCs greater than 5 ppm).

Engineering controls were utilized to limit contact with site groundwater and control the production of nuisance dusts.

No recordable accidents occurred during the RA activities. Several minor incidents, including near miss events, were observed over the duration of the project. These are documented in **Appendix T**.

Section 7
Operation and Maintenance

Routine O&M includes sampling and monitoring of the facility and site monitoring wells to verify that the treatment system is operational and maintained as per the design requirements. O&M at the site is being performed by CTI and Associates, Inc. (CTI), of Wixom, MI, under a Long-term Remedial Action (LTRA) Contract with USACE. Any deficiencies identified during the one year O&M period are covered under the facility warrantee and will be corrected. These activities are further described below.

7.1 Routine Operation and Maintenance

A copy of the O&M Manual is included as **Appendix U**. Routine O&M activities include:

- Operation of all equipment, systems, processes and appurtenances in accordance with the contract documents and manufacturers specifications
- Procurement, management and maintenance of all equipment, spare parts, supplies and services required for continuous operation with minimal downtime
- Optimization of process equipment to minimize operational costs
- Maintenance of treatment plant uptime greater than 90 percent during the first year of operation
- Monitoring of treatment system performance, permit compliance and remedial progress by collecting samples and field measurements in accordance with the contract and permit requirements
- Routine preventative and corrective maintenance of the treatment facilities, including all processes, equipment, controls, facilities and appurtenances
- Determining the frequency of vapor phase carbon change-out
- Containerizing, characterizing, transporting and disposing of all process and sampling waste residuals at an approved waste disposal facility in accordance with offsite transportation and disposal procedures.

Routine preventative and corrective maintenance of the treatment facility, including all processes, equipment, controls, facilities and appurtenances, includes but is not limited to:

- Change-out of bag filters
- Change-out of vapor phase GAC units
- Cleaning of process equipment as often as necessary to prevent plugging, etc.
- Cleaning of the basket strainer
- Venting of valves
- Wash-down of process equipment
- Lubrication of process equipment
- Cleanout of process and yard piping
- Alignment of pump and blower shafts
- Instrumentation cleaning and calibration
- Periodic cleaning of the air-stripper trays
- Maintenance and re-development of the extraction wells as required
- Routine inspections and maintenance of exterior facilities, equipment, grounds, including fencing, access roads, locks, vegetation, stormwater catch basins and drainage pipes and swales, clean-out manhole, touch-up painting, well vault leaks, structural support systems, and building openings and access ways

7.2 Environmental Sampling and Monitoring

The following environmental sampling will be performed as part of the O&M activities:

- Performance monitoring of the groundwater treatment system to verify that the system and individual components are operating properly and that compliance with the NJPDES-DSW and Air Pollution Control permit equivalents are being maintained. A summary of the performance monitoring program is provided in **Table 7-1**.
- Routine monitoring of site-wide groundwater to verify remedy effectiveness, hydraulic control, and to monitor remedial progress. A summary of the groundwater monitoring program and parameters is provided in **Table 7-1**.

7.3 Reporting

Information and data collected during O&M and environmental sampling/monitoring activities will be routinely evaluated and documented as part of Monthly O&M Report and quarterly/annual Remedial Action Progress Report submittals. The reports will be completed by CTI or their subcontractor.

Information and data collected during O&M and environmental sampling/monitoring activities will be documented by the LTRA Contractor and submitted as part of monthly O&M status reports to USACE. These reports will include the following:

- Inspection report including system integrity, presence of settling or subsidence, solids buildup, scaling, plugging, fouling, vandalism, etc.
- Maintenance recommendations, completed maintenance, and/or repairs completed
- Operating conditions, including quantities of consumables used, and flow records with flow rates and total flow
- Any operational problems encountered
- Site visitors
- Shipments received
- Tabulated results of performance, compliance and environmental monitoring activities completed and validated laboratory results of analyzed samples
- Supply inventory
- Any H&S activities that occurred or issues that were identified
- Waste disposal quantities and copies of characterization sample results and disposal records/manifests

Remedial Progress Reports will be prepared for submittal to USACE, EPA and NJDEP on a quarterly basis. The reports will include a detailed summary and analysis of remedy performance, including, without limitation:

- Tabulated summary tables for groundwater data and field measurements
- Tabulated summary table of compliance sampling and monitoring results to demonstrate conformance with the NJPDES-DSW and air discharge criteria
- Tabulated/graphed summary of GWTF performance, including average flow rates and cumulative volume of groundwater extracted, mass removal rates and cumulative mass removed, and percent operational uptime
- Groundwater elevation iso-contour maps and capture zone estimates
- Groundwater contamination iso-concentration maps
- Graphs for updated groundwater contamination concentration trend analyses
- Written summary, assessment, and discussion of remedial action progress for the reporting period

- Recommendations regarding future O&M activities
- A data usability summary for the quarterly groundwater sampling events

Pursuant to EPA requirements, a Five Year Review of the site will be performed after five years of facility operations and will consist of a comprehensive evaluation of the groundwater remedy.

7.4 Institutional Controls

NJDEP will be responsible for monitoring that contaminated water from the aquifer will not be used for potable or non-potable purposes without treatment.

A MOA, which includes the use of the Gee property for off-site compensation as required by FHA regulation, is in place between EPA and Rockaway Borough for implementation of the remedy. A deed notice was required on the Gee property, which prevents the property from being used for flood compensation in the future.

Section 8
Summary of Project Costs

The Rockaway Borough Superfund Site, East Main/Wall Street Plume RA construction contract was executed as a firm fixed price contract. The work was completed under PRAC, Contract Number W912DQ-05-D-0001, Task Order 0005, awarded through USACE Kansas City District.

Table 8-1 provides a summary of the actual RA project costs including its engineering services provided by USACE, RA Contractor services provided by CAPE, and its subcontractors. The total project RA cost was $9,104,005, which includes the base construction RA Contract cost and contract modifications, USACE NY District oversight and project management, USACE KC District technical management and contracting, management & support fees. Two CCRs were issued over the course of the project. The total value of the CCRs was $52,698, as detailed in **Table 8-2**, and included in **Appendix Q**.

Note that the total cost includes a period of project hiatus between March 2008 and May 2010, due to uncertainty of the plume location and effectiveness of the original design. USACE and EPA maintained presence at the site during this period, while an additional PDI took place. When the RA resumed, the scope was expanded to include four additional extraction wells, as recommended by the PDI Report.

Section 9
Observations and Lessons Learned

The following provides a summary of significant observations and lessons learned during the groundwater treatment system construction activities:

- The original RD was completed by the PRP, and submitted to EPA, who then transferred it to USACE. Several options for treatment building location were considered during the PRP design. Pre-mobilization activities included review of the RD, prior to beginning construction. During pre-mobilization activities it was determined that the treatment building location was designed on a property that was restricted by the New Jersey GAP, which provides funding to municipalities to preserve open and recreational spaces, and maintains a database of funded spaces known and the Recreational and Open Space Inventory (ROSI). Therefore the treatment building required relocation, in an effort to minimize schedule impact. Attempting to appeal the restriction would have caused an even greater delay to the project, and the outcome of the appeal was uncertain. Future projects that intend to use municipally-owned property for remedial construction should check the ROSI before proceeding with design. This should be done early in the project, when permit equivalencies are identified.

- In November 2007, NJDEP adopted new FHA Control Act Rules, which had two major impacts on the project design. First, the Zero Net Fill provision required the project scope to expand to include off-site compensation due to limited space on the treatment system property to perform excavation to offset fill. The project team worked with the Borough of Rockaway to identify a property that met the criteria for off-site compensation. Then it prepared the design documents and permit application, revised the MOA, and executed the construction. Second, in addition to the flood-proof door, the structural design was required to account for hydrostatic pressure up to the design flood elevation, impact from water and debris during the design flood, uplift, flotation, collapse and displacement due to hydrostatic and hydrodynamic forces resulting from the design flood, and overturning and sliding pressure. The result was a more robust building than the original design.

- Due to the location of an existing well house at the site that houses one of the Rockaway Borough potable water supply wells, the existing well house was required to be demolished due to severe space constraints. Because the new GWTF was to be located under the same roof structure as the water supply well, it was determined that the N.J.A.C. wellhead protection requirements could not be met, and an ARAR waiver letter was required from the EPA (dated March 3, 2008). The new well house for the existing water supply well was incorporated into the new building with the well house located in a separate room adjacent to the new GWTF within the same new building structure. The wall constructed between the new GWTF and the supply well house rooms was required to be solid without penetrations, with the only exception being the GW-1 drain line to the GWTF sump.

- A thorough understanding of this dynamic and complicated aquifer is essential to successful remediation. The original RD included 3 extraction wells, the locations of which were determined by the site conceptual model plume location. However, during RA construction it became clear that the influence of the Rockaway wells on the plume was not understood, and further PDI was conducted, which changed the former understanding of the site conceptual model significantly. Additional monitoring wells and piezometers were installed to investigate the extent of the groundwater contamination. The results of the additional PDI recommended realignment of the extraction wells, and determined that one of the existing extraction wells, EW-7, was not optimally located in the groundwater flow field and was found to be free of contamination.

- Due to the required design and construction schedule, the final GWTF design was required to be completed prior to installation of the new extraction wells and completion of the influent piping design and subsequent extraction well pump selection. The most recent sampling data available at the time therefore did not include wells within the most concentrated areas of the plume. The uncertainties in the influent concentrations and other influent design parameters (line pressures, etc.) required the use of greater safety factors during the design of the system and also could have resulted in additional design and field changes.

- Due to the need for flexibility in the extraction well system, the design was required to accommodate a wide range of flows for each extraction well. Compounding the fluctuations of flows from multiple wells causes significant variations in flow rates in the main influent piping header. Complex hydraulic modeling of the extraction wells and piping system using a significant number of pumping scenarios was required to be analyzed to ensure that minimum and maximum design velocities would be met and that the extraction well pumps would function over the wide range of flows. Because the extraction well pump VFDs are not able to run at less than 50 percent speed (in hertz), it was determined that for some scenarios, the VFDs were unable to operate the extraction well pumps at the lower end of the operating range. In these instances, the flow will have to be reduced by throttling the gate valve located in the extraction well vault.

- It is important to get agreement in writing from local stakeholders when its operations are affected by RA construction. Rockaway Borough, as owner of GW-1, is responsible for providing drinking water in compliance with its permit. Several planning meetings were held in which the parameters for bypass pumping rates for GW-1 were discussed and agreement was assumed. However, despite the agreement very late in the process, the Borough informed EPA that the bypass pumping rate was inadequate, and major changes to the temporary bypass pumping system were required which delayed the schedule.

- EPA preferred to drill all the extraction wells in the public right-of-way, and not on private property. Because of the narrow streets in Rockaway Borough, drilling, well installation, trenching, and vault installation all required the streets to be closed to traffic at least one lane. CAPE maintained communication with residents affected by construction in the streets adjacent to their properties. This required the cooperation of public safety officials, township officials, USACE and EPA. CAPE maintained daily communication with Rockaway Police department during the RA. This ensured the drilling, trench excavation, and building construction activities potentially affecting public safety were conducted without incident.

- The region experienced a major storm, Hurricane Irene, which impacted the region from August 27 to September 5, 2011. The Rockaway River overflowed its banks in the vicinity of the site, and there was floodwater at the building site. At this point in the project the building was secure; however the windows, man door, and flood door had not yet been installed. CAPE spent part of the workday prior to the storm on Friday August 26, 2011 in preparation, securing the equipment and materials at the building site, along the trench route, at the Gee Property, and at the lay-down yard in Friendship Park. The preparation ensured that there was no storm-related damage aside from minor erosion at the building site. However, due to floodwaters that persisted in the region, work was suspended for two days following the storm.

- Air sample results from the startup sampling in November 2011 showed levels of acetone, THF, and MEK in excess of permit limit for total VOCs for all effluent samples and the permit limit for total HAPs for one effluent sample. Acetone and THF are not HAPs. These three compounds are the predominant ingredients of low-VOC pipe glue and solvent used to assemble the air piping. In subsequent sampling in December 2011, high concentrations of acetone and MEK were still observed, although THF was not detected. The presence of these particular compounds indicates a potential problem associated with the air piping. It is recommended that the activities described in the ITP Report included in **Appendix R** be performed to investigate and remedy this issue.

- Approximately 50,000 kWHs of 100 percent of renewable energy were used during construction, and approximately 5,500 tons of waste materials generated during construction activities were recycled.

Section 10
Contact Information

Contact information for key project personnel at the time of project completion is presented below. A detailed contact list is included in **Table 10-1**.

Name	Title	Organization	Address
Brian Quinn	Project Manager	EPA	290 Broadway, 19th Floor New York, NY 10007-1866
Saqib Khan	Project Manager	USACE Kansas City	601 East 12th Street Kansas City, MO 64106
Tom Cimarelli, P.E.	Project Manager	USACE New York	26 Federal Plaza Room 1811 New York, NY 10278-0004
Neal Kolb, P.E.	Resident Engineer	USACE New York	214 State Highway 18 North East Brunswick, NJ 08816
David Bettendorf, P.G.	Project Manager	CAPE	6851 Oak Hall Lane Columbia, MD 21045
Kershu Tan, P.E.	Project Manager	CDM Smith	110 Fieldcrest Avenue, #8, 6th Fl. Edison, NJ 08837

Section 11
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Table 2-1
Groundwater Clean-up Criteria
Rockaway Borough Superfund Site - East Main/Wall Street Plume - OU2
Rockaway Borough, New Jersey

Chemical Name	Remediation Goals (µg/L)
Benzene	1
Bromochloromethane	100
Carbon Tetrachloride	1
Chlorobenzene	50
Chloroform	70
1,2-Dichloroethane	2
1,1-Dichloroethene	1
cis-1,2-Dichloroethene	70
trans-1,2-Dichloroethene	100
1,2-Dichloropropane	1
Ethylbenzene	700
Tetrachloroethene	1
1,1,1-Trichloroethane	30
Trichloroethene	1
Vinyl Chloride	1
m,p-Xylene	1000
o-Xylene	1000

Acronyms:

µg/L - microgram per liter

Table 2-2
NJPDES-DSW Permit Equivalency Criteria
Rockaway Borough Superfund Site - East Main/Wall Street Plume - OU2
Rockaway Borough, New Jersey

Parameter	Units	Daily Minimum	Monthly Average	Daily Maximum
Flow	gpd	NL	(1)	(1)
pH	Standard Unit	6.0	NL	9.0
Total Suspended Solids (TSS)	mg/L	NL	(1)	40
Total Organic Carbon	mg/L	NL	(1)	20
Chronic Toxicity, IC25	%	61 (1) (2)	NL	NL
Tetrachloroethylene (PCE)	µg/L	NL	NL	16
Tichloroethylene (TCE)	µg/L	NL	NL	5.4
1,1-Dichloroethylene (DCE)	µg/L	NL	NL	6
Chromium	µg/L	NL	50	100
Copper	µg/L	NL	50	100
Nickel	µg/L	NL	72	144
Zinc	µg/L	NL	100	200

Acronyms:

NL - not listed

gpd - gallons per day

mg/L - milligrams per liter

µg/L - micrograms per liter

% - percentage

NJPDES- New Jersey Pollution Discharge Elimination System

DSW - Discharge to Surface Water

Notes:

(1) Monitor and report only

(2) The final limitation of 61% becomes mandatory at the Effective Date of Permit Equivalency + 3 years

Table 2-3
NJDEP Air Pollution Control Permit Equivalency Criteria
Rockaway Borough Superfund Site - East Main/Wall Street Plume - OU2
Rockaway Borough, New Jersey

Parameter	Units	Daily Maximum
Flow (Groundwater through Stripper)	gpm	≤ 210
VOC (Total)	lb/hr	≤ 0.03
HAPs (1)	lb/hr	≤ 0.03
Tetrachloroethylene	lb/hr	≤ 0.03
Operating VOC Control Efficiency	%	≥ 95

Acronyms:

gpm - gallons per minute

lb/hr - pounds per hour

≤ - less than or equal to

≥ - greater than or equal to

% - percentage

NJDEP - New Jersey Department of Environmental Protection

VOC - volatile organic compounds

EPA - Environmental Protection Agency

Notes:

(1) HAPs- EPA's list of Hazardous Air Pollutants

Table 3-1
Subcontractor Information
Rockaway Borough Wellfied Superfund Site - East Main/Wall Street Plume - OU2
Rockaway Borough, NJ

Subcontractor	***Location***	***Role***
CDM Smith	Edison, NJ	RD Support
B&B Drilling Co., Inc.	Netcong, NJ	Drilling
Frontz Drilling, Inc.	Wooster, OH	
Miller Drilling, Inc.	Lawrenceburg, TN	
A.C. Schultes	Woodbury Heights, NJ	Extraction Well Pump Installation
B.L. Myers Bros.	Manahawkin, NJ	NJ-Licensed Driller Services
Katahdin Analytical Services, Inc.	Scarbourough, ME	Analytical Laboratory
Accutest Laboratories	Dayton, NJ	
QC Laboratories, Inc.	Southampton, PA	
Valley Forge Laboratories, Inc.	Devon, PA	
TestAmerica Laboratories, Inc.	Arvada, CO	
TTI Inc.	Moorestown, NJ	GW-1 Asbestos, Lead and Structural Survey
Abatetech, Inc.	Lumberton, NJ	Asbestos Abatement
M&A Tree Service	Garwood, NJ	Tree Removal
ANS Consultants, Inc.	South Plainfield, NJ	Geotechnical, Pavement & Concrete Testing
LAN Associates	Midland Park, NJ	Surveying
Yu & Associates, Inc.	Elmwood Park, NJ	Site Civil and QC
Ehrich Electric, Inc.	East Hanover, NJ	Electrical
Hi-Volt Electric, LLC	Laurence Harbor, NJ	
Innovative Controls Inc	Knoxville, TN	Process Instrumentation and Controls
Groundwater Treatment and Technology, Inc. (GTTI)	Denville, NJ	Temporary Treatment Plant O&M
Alimi Builders, Inc.	Wyckoff, NJ	Building
Abbott O'Reilly Contracting	Verona, NJ	Building Roof
Intex Commercial Door Systems	Randolph, NJ	Window and Flood Door Installation
Warren Lightning Rod Company	Collingswood, NJ	Lightning Protection
Enviroscapes, Inc.	Monmouth Junction, NJ	Site Work & Landscaping
York Fence Co.	Hillsborough, NJ	Fence
Pave-Rite, Inc.	Bridgewater, NJ	Paving, Curb & Sidewalk
Bigler Associates, Inc. (BAI)	Lakewood, NJ	GWTF Startup O&M
Maddox Materials	Spotswood, NJ	Material Transportation
Soil Safe, Inc.	Logan, NJ	Soil and Debris Disposal
Morris Security Group LLC	Randolph, NJ	Fire & Security Alarm

Table 3-7
Green Remediation Summary
Rockaway Borough Superfund Site - East Main/Wall Street Plume - OU2
Rockaway Borough, New Jersey

Source	Electric/Recycling Type	Quantity	Provider
Electrical Service - Groundwater Treatment Facility	Electric Alternative: 50% Wind/1% Solar/ 49% Low-Impact Hydro	34,932 KWH	Community Energy, Inc. 100 Masterford Road Radnor, PA 19087
Electrical Service - Friendship Field Laydown Yard	Electric Alternative: 50% Wind/1% Solar/ 49% Low-Impact Hydro	52 KWH	Community Energy, Inc. 100 Masterford Road Radnor, PA 19087
Electrical Service - CAPE Field Office	Electric Alternative: 50% Wind/1% Solar/ 49% Low-Impact Hydro	4,074 KWH	Community Energy, Inc. 100 Masterford Road Radnor, PA 19087
Electrical Service - USACE Field Office	Electric Alternative: 50% Wind/1% Solar/ 49% Low-Impact Hydro	10,990 KWH	Community Energy, Inc. 100 Masterford Road Radnor, PA 19087
Building Demolition Debris	Class B Recycling	112.40 Tons	Pure Soil Technologies 655 South Hope Chapel Road Jackson, NJ 08527
Sidewalk and Curb Debris	Class B Recycling	136.91 Tons	Pure Soil Technologies 655 South Hope Chapel Road Jackson, NJ 08527
Asphalt Debris	Class B Recycling	651 Tons	Weldon Materials 181 State Highway 181 Lake Hopatcong, NJ 07849
2011 Drill, Building, and Trench Spoils	Class B Recycling	4,339.39 Tons	Soil Safe Inc. - Bridgeport 378 Route 130 Logan Township, NJ 08085
Gee Property Excavation Spoils	Class B Recycling	271.86 Tons	Soil Safe Inc. - Bridgeport 378 Route 130 Logan Township, NJ 08085
Light Metal	Class A Recycling	1.28 Tons	Evergreen Recycling Solutions LLC 110 Evergreen Ave Newark, NJ 07114

Table 6-1
Baseline Groundwater Monitoring Results - April 2011
Rockaway Borough Superfund Site - East Main/Wall St. Plume - OU2
Rockaway Borough, New Jersey

Location ID: Sample Date: Unit: **Chemical Name**	**Remediation Goals** **µg/L**	**EW-5** **4/13/2011** **µg/L**	**EW-5 DUP** **4/13/2011** **µg/L**	**EW-5A** **4/19/2011** **µg/L**	**EW-6** **4/15/2011** **µg/L**	**EW-7** **4/12/2011** **µg/L**	**EW-7A** **4/12/2011** **µg/L**	**EW-8** **4/19/2011** **µg/L**	**EW-9** **4/19/2011** **µg/L**	**EW-10** **4/19/2011** **µg/L**	**GW-1** **4/15/2011** **µg/L**	**GW-5** **4/12/2011** **µg/L**	**GW-5 DUP** **4/12/2011** **µg/L**	**GW-6** **4/12/2011** **µg/L**	**MW-1A** **4/15/2011** **µg/L**	**MW-1D** **4/15/2011** **µg/L**	**MW-1R** **4/15/2011** **µg/L**	**MW-2D** **4/13/2011** **µg/L**	**MW-3D** **4/12/2011** **µg/L**
1,1-Dichloroethene	1	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	***2.3***	0.5 U	0.5 U	0.5 U	0.5 U
Acetone	6000	5 U	5 U	50 U	5 U	5 U	5 U	50 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	***9.4***
Carbon Disulfide	700	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	***29***	0.5 U
trans-1,2-Dichloroethene	100	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U	5 U	***0.55***	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methyl tert-Butyl Ether	70	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethane	50	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
cis-1,2-Dichloroethene	70	0.5 U	0.5 U	5 U	***8.5***	0.5 U	0.5 U	***30***	***240***	***19***	***1.6***	0.5 U	0.5 U	0.5 U	***200***	0.5 U	0.5 U	0.5 U	0.5 U
1,1,1-Trichloroethane	30	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	***2.8***	0.5 U	0.5 U	0.5 U	0.5 U
Carbon Tetrachloride	1	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	***1.7 K***	0.5 U	0.5 U	0.5 U	0.5 U
Benzene	1	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	***1.6***	0.5 U
Trichloroethene	1	0.5 U	0.5 U	5 U	***1.6***	0.5 U	0.5 U	***7.5***	***18***	***3.4***	***0.51***	0.5 U	0.5 U	***1.9***	***130***	0.5 U	0.5 U	0.5 U	0.5 U
Toluene	600	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	***0.64***	0.5 U
Tetrachloroethene	1	***140***	***130***	***2,300***	***230***	***0.66***	0.5 U	***5,100***	***530***	***440***	***50***	***2.4***	***2.3***	***28***	***170,000***	1 U	***1.2***	0.5 U	0.5 U
Chlorobenzene	50	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	***3***	0.5 U	0.5 U	0.5 U	0.5 U
o-Xylene	1000	0.5 U	0.5 U	5 U	0.5 U	***0.51***	0.5 U	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
m,p-Xylene	1000	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U	5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	***0.61*** L	0.5 U	0.5 U	0.5 U	0.5 U

Notes:
1. Detected values are bolded and italicized
2. Values that exceed the Remediation Goals are highlighted.

U - Not detected above reported quantitation limit
K - The identification of the analyte is acceptable; the reported value may be biased high.
L -The identification of the analyte is acceptable; the reported value may be biased low.
µg/L - micrograms per liter
DUP - field duplicate sample

Table 6-1
Baseline Groundwater Monitoring Results - April 2011
Rockaway Borough Superfund Site - East Main/Wall St. Plume - OU2
Rockaway Borough, New Jersey

Location ID:	Remediation	PZ-1	PZ-2	PZ-3	PZ-4	PZ-5	PZ-5 DUP	PZ-6	PZ-7	PZ-8	PZ-9A	PZ-9B	PZ-9C	PZ-10A	PZ-10B	PZ-10C	PZ-11A	PZ-11B	PZ-11C	PZ-12A
Sample Date:	Goals	4/11/2011	4/11/2011	4/11/2011	4/12/2011	4/18/2011	4/18/2011	4/15/2011	4/18/2011	4/18/2011	4/13/2011	4/13/2011	4/13/2011	4/15/2011	4/15/2011	4/15/2011	4/15/2011	4/15/2011	4/15/2011	4/18/2011
Unit:	ug/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	ug/L
Chemical Name																				
1,1-Dichloroethene	1	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Acetone	6000	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Carbon Disulfide	700	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
trans-1,2-Dichloroethene	100	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methyl tert-Butyl Ether	70	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	***0.68***	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethane	50	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
cis-1,2-Dichloroethene	70	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	***1.2***	***7.6***	0.5 U	0.5 U	0.5 U	0.5 U	***25***	***0.94***	0.5 U	***2.7***	***0.88***	0.5 U	***12***
1,1,1-Trichloroethane	30	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Carbon Tetrachloride	1	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Benzene	1	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Trichloroethene	1	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	***0.62***	***1.7***	***0.59***	0.5 U	0.5 U	0.5 U	***4.1***	***0.56***	0.5 U	0.5 U	***0.58***	0.5 U	***2.1***
Toluene	600	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Tetrachloroethene	1	0.5 U	0.5 U	0.5 U	0.5 U	***2.9***	***2.9***	***810***	***1,300***	***15***	0.5 U	***9.6***	***3***	***560***	***330***	***2.5***	***63***	***250***	***2.6***	***58***
Chlorobenzene	50	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
o-Xylene	1000	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
m,p-Xylene	1000	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U

Notes:
1. Detected values are bolded and italicized
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K - The identification of the analyte is acceptable; the reported value may be biased high.
L -The identification of the analyte is acceptable; the reported value may be biased low.
µg/L - micrograms per liter
DUP - field duplicate sample

Table 6-1
Baseline Groundwater Monitoring Results - April 2011
Rockaway Borough Superfund Site - East Main/Wall St. Plume - OU2
Rockaway Borough, New Jersey

Location ID: Sample Date: Unit: Chemical Name	Remediation Goals ug/L	PZ-12B 4/18/2011 µg/L	RBW-01 4/19/2011 µg/L	RBW-02 4/15/2011 µg/L	RBW-04 4/18/2011 µg/L	RBW-06 4/18/2011 µg/L	RBW-08A 4/18/2011 µg/L	RBW-09 4/11/2011 µg/L	RBW-10 4/12/2011 µg/L	RBW-11 4/15/2011 µg/L
1,1-Dichloroethene	1	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Acetone	6000	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Carbon Disulfide	700	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
trans-1,2-Dichloroethene	100	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methyl tert-Butyl Ether	70	***200***	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethane	50	***0.51***	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
cis-1,2-Dichloroethene	70	***0.88***	0.5 U	***2.6***	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	***960***
1,1,1-Trichloroethane	30	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Carbon Tetrachloride	1	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Benzene	1	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Trichloroethene	1	0.5 U	0.5 U	***0.67***	0.5 U	***12***	0.5 U	0.5 U	0.5 U	***4.8***
Toluene	600	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Tetrachloroethene	1	***26***	***11***	***55***	1 U	1 U	1 U	0.5 U	0.5 U	***1,000***
Chlorobenzene	50	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
o-Xylene	1000	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
m,p-Xylene	1000	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U

Notes:
1. Detected values are bolded and italicized
2. Values that exceed the Remediation Goals are highlighted.

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L -The identification of the analyte is acceptable; the reported value may be biased low.
µg/L - micrograms per liter
DUP - field duplicate sample

Table 6-1
Baseline Groundwater Monitoring Results - April 2011
Rockaway Borough Superfund Site - East Main/Wall St. Plume - OU2
Rockaway Borough, New Jersey

Location ID: Sample Date: Unit: Chemical Name	Remediation Goals ug/L	RBW-12 4/18/2011 µg/L	RBW-14 4/18/2011 µg/L	RBW-15 4/19/2011 µg/L	RBW-22S 4/19/2011 µg/L	SAI-1 4/15/2011 µg/L	SAI-2 4/13/2011 µg/L	SAI-3 4/15/2011 µg/L	SAI-4 4/19/2011 µg/L
1,1-Dichloroethene	1	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Acetone	6000	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Carbon Disulfide	700	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
trans-1,2-Dichloroethene	100	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methyl tert-Butyl Ether	70	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethane	50	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
cis-1,2-Dichloroethene	70	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,1-Trichloroethane	30	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Carbon Tetrachloride	1	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Benzene	1	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Trichloroethene	1	0.5 U	***1.6***	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Toluene	600	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Tetrachloroethene	1	1 U	1 U	***2.6***	1 U	***1.2***	0.5 U	***2.6***	1 U
Chlorobenzene	50	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
o-Xylene	1000	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
m,p-Xylene	1000	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U

Notes:
1. Detected values are bolded and italicized
2. Values that exceed the Remediation Goals are highlighted.

U - Not detected above reported quantitation limit
K - The identification of the analyte is acceptable; the reported value may be biased high.
L -The identification of the analyte is acceptable; the reported value may be biased low.
µg/L - micrograms per liter
DUP - field duplicate sample

Table 6-2
Extraction Well Monitoring Summary
Rockaway Borough Superfund Site - East Main/Wall Street Plume - OU2
Rockaway Borough, New Jersey

Extraction Well			**EW5A**					**EW6**					**EW8**				
Sample Identification	**Reporting Limit**		**RBGWEW5A001**	**RBGWEW5A002**	**RBGWEW5A003**	**RBGW5A004**	**Average**	**RBGWEW6001**	**RBGWEW6002**	**RBGWEW6003**	**RBGWEW6004**	**Average**	**RBGWEW8001**	**RBGWEW8002**	**RBGWEW8003**	**RBGWEW8004**	**Average**
Lab Identification			**SE7435-4**	**SE7617-6**	**SE7786-5**	**SE7797-3**	**-**	**SE7592-4**	**SE7617-9**	**SE7786-6**	**SE7797-7**	**-**	**SE7470-4**	**SE7617-4**	**SE7786-7**	**SE7797-2**	**-**
Date	**Monthly Average**	**Daily Maximum**	**11/07/11**	**11/14/11**	**11/18/11**	**11/19/11**	**-**	**11/11/11**	**11/14/11**	**11/18/11**	**11/19/11**	**-**	**11/08/11**	**11/14/11**	**11/18/11**	**11/19/11**	**-**
Volatile Organic Compounds (µg/L)																	
Tetrachloroethene	1 [1]		**39**	**130 J**	**190**	**190**	**137**	**69 J**	**64 J**	**81**	**85**	**77**	**110**	**140 J**	**330**	**360**	**235**
Metals (µg/L)																	
Aluminum, Total	---	---	40 U	NA	NA	NA	-	40 U	NA	NA	NA	-	40 U	NA	NA	NA	-
Antimony, Total	---	---	0.50U	NA	NA	NA	-	0.50U	NA	NA	NA	-	0.50U	NA	NA	NA	-
Arsenic, Total	50	100	**2.9J**	NA	NA	NA	-	4.0U	NA	NA	NA	-	4.0U	NA	NA	NA	-
Barium, Total	---	---	**23.5**	NA	NA	NA	-	**38.7**	NA	NA	NA	-	**31.8**	NA	NA	NA	-
Beryllium, Total	---	---	0.20U	NA	NA	NA	-	0.20U	NA	NA	NA	-	0.20U	NA	NA	NA	-
Cadmium, Total	50	100	0.20U	NA	NA	NA	-	0.20U	NA	NA	NA	-	0.20U	NA	NA	NA	-
Calcium, Total	---	---	**43,300**	NA	NA	NA	-	**63,100**	NA	NA	NA	-	**48,300**	NA	NA	NA	-
Chromium, Total	50	100	4.0 U	NA	NA	NA	-	**0.44J**	NA	NA	NA	-	4.0 U	NA	NA	NA	-
Cobalt, Total	---	---	**0.23J**	NA	NA	NA	-	**0.18J**	NA	NA	NA	-	**0.26J**	NA	NA	NA	-
Copper, Total	50	100	2.0 U	NA	NA	NA	-	2.0U	NA	NA	NA	-	2.0 U	NA	NA	NA	-
Iron, Total	---	---	**84.5J**	NA	NA	NA	-	60U	NA	NA	NA	-	96.1 U	NA	NA	NA	-
Lead, Total	50	100	0.50U	NA	NA	NA	-	0.50U	NA	NA	NA	-	0.50U	NA	NA	NA	-
Magnesium, Total	---	---	**13,700**	NA	NA	NA	-	**24,300**	NA	NA	NA	-	**15,900**	NA	NA	NA	-
Manganese, Total	---	---	1.9 U	NA	NA	NA	-	1.0U	NA	NA	NA	-	1.7 U	NA	NA	NA	-
Mercury, Total	---	1	0.10U	NA	NA	NA	-	0.10U	NA	NA	NA	-	0.10U	NA	NA	NA	-
Nickel, Total	72	144	**4.9**	NA	NA	NA	-	**1.8J**	NA	NA	NA	-	**8.3**	NA	NA	NA	-
Potassium, Total	---	---	**3,320**	NA	NA	NA	-	**3,400**	NA	NA	NA	-	**3,950**	NA	NA	NA	-
Selenium, Total	50	100	3.0 U	NA	NA	NA	-	3.0U	NA	NA	NA	-	3.0 U	NA	NA	NA	-
Silver, Total	25	50	0.40U	NA	NA	NA	-	0.40U	NA	NA	NA	-	0.40U	NA	NA	NA	-
Sodium, Total	---	---	**119,000**	NA	NA	NA	-	**142,000**	NA	NA	NA	-	**148,000**	NA	NA	NA	-
Thallium, Total	---	---	0.40U	NA	NA	NA	-	0.40U	NA	NA	NA	-	0.40U	NA	NA	NA	-
Vanadium, Total	---	---	**1.5J**	NA	NA	NA	-	4.0U	NA	NA	NA	-	4.0 U	NA	NA	NA	-
Zinc, Total	---	---	**32.8**	NA	NA	NA	-	**22.6**	NA	NA	NA	-	**30.8**	NA	NA	NA	-
Wet Chemistry Parameters																	
Specific Conductivity (µmho/cm)	---	---	NA	NA	NA	NA	-	**1200**	NA	NA	NA	-	**1100**	NA	NA	NA	-
Total Organic Carbon (mg/L)	Report	20	**0.59J**	NA	NA	NA	-	**0.77J**	NA	NA	NA	-	**0.65J**	NA	NA	NA	-
Alkalinity (mg/L)	---	---	**56**	NA	NA	NA	-	**100**	NA	NA	NA	-	**63**	NA	NA	NA	-
Hardness (mg/L)	---	---	**150**	NA	NA	NA	-	**260**	NA	NA	NA	-	**170**	NA	NA	NA	-
Total Suspended Solids (mg/L)	Report	40	**940**	NA	NA	NA	-	3.0U	NA	NA	NA	-	**2.0J**	NA	NA	NA	-

Notes:
1. VOC limits based on N.J.A.C 7:10 Safe Drinking Water Act MCLs for State-Regulated VOCs. All other values based on the NJDPES-DSW permit equivalent discharge limits.
2. Bold results indicate positively detected value.

µg/L-microgram per liter
mg/L - milligram per liter
U - not detect
J - estimated value
N.J.A.C - New Jersey
µmho/cm- micromho per centimeter
NA - not analyzed
NJDPES - New Jersey Pollutant Discharge Elimination System
DSW - discharge to suface water
MCL - maximum contaminant limit
VOC - volatile organic compound

Table 6-2
Extraction Well Monitoring Summary
Rockaway Borough Superfund Site - East Main/Wall Street Plume - OU2
Rockaway Borough, New Jersey

Extraction Well			**EW9**					**EW10**				
Sample Identification	**Reporting Limit**		**RBGWEW9010**	**RBGWEW9002**	**RBGWEW9003**	**RBGWEW9004**	**Average**	**RBGWEW10001**	**RBGWEW10002**	**RBGWEW10003**	**RBGWEW10004**	**Average**
Lab Identification			**SE7503-5**	**SE7617-7**	**SE7786-8**	**SE7797-4**	**-**	**SE7553-4**	**SE7617-8**	**SE7786-4**	**SE7797-5**	**-**
Date	**Monthly Average**	**Daily Maximum**	**11/09/11**	**11/14/11**	**11/18/11**	**11/19/11**	**-**	**11/10/11**	**11/14/11**	**11/18/11**	**11/19/11**	**-**
Volatile Organic Compounds (µg/L)												
Tetrachloroethene	1 [1]		**70**	**79 J**	**140**	**160**	**112**	**200**	**200 J**	**220**	**230**	**213**
Metals (µg/L)												
Aluminum, Total	---	---	40 U	NA	NA	NA	-	40 U	NA	NA	NA	-
Antimony, Total	---	---	0.50U	NA	NA	NA	-	0.50U	NA	NA	NA	-
Arsenic, Total	50	100	4.0U	NA	NA	NA	-	4.0U	NA	NA	NA	-
Barium, Total	---	---	**53.4**	NA	NA	NA	-	**47.6**	NA	NA	NA	-
Beryllium, Total	---	---	0.20U	NA	NA	NA	-	0.20U	NA	NA	NA	-
Cadmium, Total	50	100	0.20U	NA	NA	NA	-	0.20U	NA	NA	NA	-
Calcium, Total	---	---	**72,400**	NA	NA	NA	-	**66,600**	NA	NA	NA	-
Chromium, Total	50	100	4.0U	NA	NA	NA	-	4.0U	NA	NA	NA	-
Cobalt, Total	---	---	**0.40J**	NA	NA	NA	-	**0.24J**	NA	NA	NA	-
Copper, Total	50	100	3.1U	NA	NA	NA	-	**1.1J**	NA	NA	NA	-
Iron, Total	---	---	88.0U	NA	NA	NA	-	60U	NA	NA	NA	-
Lead, Total	50	100	0.5U	NA	NA	NA	-	0.5U	NA	NA	NA	-
Magnesium, Total	---	---	**21,700J**	NA	NA	NA	-	**24,200**	NA	NA	NA	-
Manganese, Total	---	---	2.0U	NA	NA	NA	-	**2.0J**	NA	NA	NA	-
Mercury, Total	---	1	0.10U	NA	NA	NA	-	0.10U	NA	NA	NA	-
Nickel, Total	72	144	**3.9**	NA	NA	NA	-	**2.1**	NA	NA	NA	-
Potassium, Total	---	---	**5,100**	NA	NA	NA	-	**3,840**	NA	NA	NA	-
Selenium, Total	50	100	3.0U	NA	NA	NA	-	3.0U	NA	NA	NA	-
Silver, Total	25	50	0.40U	NA	NA	NA	-	0.40U	NA	NA	NA	-
Sodium, Total	---	---	**219,000**	NA	NA	NA	-	**140,000**	NA	NA	NA	-
Thallium, Total	---	---	0.40U	NA	NA	NA	-	0.40U	NA	NA	NA	-
Vanadium, Total	---	---	**1.5J**	NA	NA	NA	-	4.0U	NA	NA	NA	-
Zinc, Total	---	---	**54.8**	NA	NA	NA	-	**17.7**	NA	NA	NA	-
Wet Chemistry Parameters												
Specific Conductivity (µmho/cm)	---	---	**1600**	NA	NA	NA	-	**1300**	NA	NA	NA	-
Total Organic Carbon (mg/L)	Report	20	**1.0**	NA	NA	NA	-	**0.83J**	NA	NA	NA	-
Alkalinity (mg/L)	---	---	**80**	NA	NA	NA	-	**86**	NA	NA	NA	-
Hardness (mg/L)	---	---	**270**	NA	NA	NA	-	**260**	NA	NA	NA	-
Total Suspended Solids (mg/L)	Report	40	3.0U	NA	NA	NA	-	3.0U	NA	NA	NA	-

Notes:
1. VOC limits based on N.J.A.C 7:10 Safe Drinking Water Act MCLs for State-Regulated VOCs. All other values based on the NJDPES-DSW permit equivalent discharge limits.
2. Bold results indicate positively detected value.

µg/L-microgram per liter
mg/L - milligram per liter
U - not detect
J - estimated value
N.J.A.C - New Jersey
µmho/cm- micromho per centimeter
NA - not analyzed
NJDPES - New Jersey Pollutant Discharge Elimination System
DSW - discharge to suface water
MCL - maximum contaminant limit
VOC - volatile organic compound

Table 6-3
Extraction Well PCE Mass Removal Rates
Rockaway Borough Superfund Site - East Main/Wall Street Plume - OU2
Rockaway Borough, New Jersey

Sample Date	Extraction Well Scenario	Sample ID	Avg Flow Rate (gpm)	Concentration of PCE (µg/L)[1]		Mass Removal Rate (lb/d)[2]	# of days operating	Total Mass Removed and Treated (lb)
14 Day Operational Test - November 5 - 17, 2011								
11/6/11	1	RBWWINF007	210	140		0.35	1	0.35
11/7/11	1	RBWWINF008	210	130		0.33	1	0.33
11/8/11	1	RBWWINF009	210	72		0.18	1	0.18
11/9/11	1	RBWWINF010	210	78		0.20	1	0.20
11/10/11	1	RBWWINF011	210	140		0.35	1	0.35
11/11/11	1	RBWWINF012	210	150		0.38	1	0.38
11/12/11	2	RBWWINF013	155	110	J	0.21	1	0.21
11/13/11 [3]	3	-	155	125		0.23	1	0.23
11/14/11 [3]	4	-	210	105		0.27	1	0.27
11/15/11 [4]	5	-	210	210		0.53	1	0.53
11/16/11	5	RBWWINF014	210	210		0.53	2	1.06
Total							**12**	**4.09**
48 Hour Performance Test - November 17 - 19, 2011								
11/18/11	Final	RBWWINF015	182	200		0.44	1	0.44
11/19/11	Final	RBWWINF016	170	170		0.35	1	0.35
Total							**2**	**0.79**
Total for ITP								**4.9**

Notes:

1. Assumes non-detects have a value of 0.
2. The mass removal rate was calculated using the following formula:
   Groundwater Influent Concentration (µg/L) x Groundwater Flow Rate (gpm) x 1440 min/day x 3.79 L/gal x 1 lb/453,600,000 µg
3. Concentrations based on average 11/14/11 well concentrations weighted by the extraction well flow rates
4. Scenario 5 results from 11/16/11 was used.

Acronyms:

CVOC - chlorinated volatile organic compound
ID - identification
gpm - gallons per minute
µg/L - microgram per liter
GWTF- groundwater treatment facility
lb/d - pound per day
min - minute
µg - microgram
L - liter
gal - gallon
ITP - Initial Testing Program
J- result is restimated

Table 6-4
Groundwater Compliance Sampling Summary
Rockaway Borough Superfund Site - East Main/Wall Street Plume - OU2
Rockaway Borough, New Jersey

			Functionality Test						14-Day Test								48-Day Test	
Sample Identification	**NJPDES Discharge Criteria**		**RBWWTFE001**	**RBWWEFF002**	**RBWWEFF003**	**RBWWEFF004**	**RBWWEFF005**	**RBWWEFF006**	**RBWWEFF007**	**RBWWEFF008**	**RBWWEFF009**	**RBWWTFE010**	**RBWWTFE011**	**RBWWTFE012**	**RBWWTFE013**	**RBWWTFE014**	**RBWWTFE015**	**RBWWTFE016**
Extraction Well			**EW-6**	**EW-6 & EW-8**	**EW-6 & EW-5a**	**EW-6 & EW-9**	**EW-10**	**All Wells**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Sampling Date			**10/21/11**	**10/25/11**	**10/26/11**	**10/26/11**	**10/27/11**	**10/27/11**	**11/06/11**	**11/07/11**	**11/08/11**	**11/09/11**	**11/10/11**	**11/11/11**	**11/12/11**	**11/16/11**	**11/18/11**	**11/19/11**
Parameter	**Monthly Average**	**Daily Maximum**																
Volatile Organic Compounds																		
Tetrachloroethene	-	16 µg/L	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.50U	**0.40J**	0.50U	**0.67J**	**0.90J**	0.5U	0.5U	0.5U
1,1-Dichloroethene	-	6 µg/L	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5UJ	1.0J	0.5U	0.5U
Trichloroethene	-	5.5 µg/L	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5UJ	**0.38J**	0.5U	0.5U
Metals																		
Aluminum, Total	---	---	40U	40U	40U	40U	40U	40U	40 U	40 U	40 U	40 U	40 U	40U	40 U	40 U	40 U	40 U
Antimony, Total	---	---	0.5U	0.5U	0.5U	0.5U	0.5U	0.5U	0.5 U	0.50U	0.50U	0.05U	0.50U	0.50U	0.50U	0.5U	0.50U	0.50 U
Arsenic, Total	50 µg/L	100 µg/L	4.0U	4.0U	4.0U	4.0U	4.0U	4.0U	4.0U	4.0U	4.0U	4.0U	4.0U	4.0U	4.0U	4.0U	4.0U	4.0 U
Barium, Total	---	---	**44.2**	**40.2**	**34.9**	44.8	**64.7**	**55.6**	**45.8**	**43.1**	**41.2**	**40.8**	**40.9**	**40.8**	**37.5**	**34**	**38.7**	**37.8**
Beryllium, Total	---	---	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20 U
Cadmium, Total	50 µg/L	100 µg/L	0.20U	0.20U	0.20U	0.20U	0.2U	0.2U	0.2 U	0.2 U	0.20U	0.20U	0.20U	0.20U	0.20U	0.20U	0.2 U	0.20 U
Calcium, Total	---	---	**70,800**	**60,700**	**60,000**	**71,000**	**91,100**	**82,200**	**67,800**	**66,600**	**65,000**	**59,200**	**61,800**	**61,200**	**59,500**	**53,200**	**58,200**	**57,600**
Chromium, Total	50 µg/L	100 µg/L	4.0U	4.0U	4.0U	4.0U	4.0U	4.0U	4.0 U	4.0 U	4.0 U	4.0U	**23.5**	**0.32J**	2.2U	4.0U	4.0 U	4.0 U
Cobalt, Total	---	---	**0.33J**	**0.44J**	**0.66J**	**0.66J**	**0.49J**	**0.69J**	**0.30J**	**0.30J**	**0.27J**	**0.22J**	**0.55J**	**0.22J**	**0.21J**	**0.22J**	**0.35J**	**0.20 J**
Copper, Total	50 µg/L	100 µg/L	2.0U	2.0U	**8.5**	2.0U	2.0U	2.0U	2.0 U	2.0 U	2.0 U	3.9U	**1.3J**	**1.3J**	2.0U	**0.91J**	2.0 U	2.0 U
Iron, Total	---	---	**180**	**92.7J**	**108**	**141**	**137**	**184**	**83.1**	**177**	72.2 U	60U	**31.1J**	60U	118U	60U	60U	60 U
Lead, Total	50 µg/L	100 µg/L	**0.22J**	0.5U	0.5U	0.5U	0.5U	0.5U	**0.1J**	**0.09J**	**0.12J**	0.5U	0.5U	0.5U	**0.09J**	0.5U	0.5 U	0.5 U
Magnesium, Total	---	---	**26,000**	**21,000**	**21,200**	**24,300**	**32,000**	**28,400**	**24,000**	**23,600**	**23,000**	**20800 J**	**22,600**	**22,300**	**21,200**	**17,500**	**21,200**	**21,000**
Manganese, Total	---	---	2.5U	**2.5**	2.0U	2.2U	**8.4**	**5.8**	2.6U	3.2 U	2.0 U	1.8U	**3.7**	1.2U	1.2U	**73.9**	**1.2J**	**1.2 J**
Mercury, Total	---	1 µg/L	0.10U	0.10UJ	0.10UJ	0.10UJ	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10U	0.10 U
Nickel, Total	72 µg/L	144 µg/L	**2.9**	**9.0**	**5.3**	**4.5**	**21.7**	**14.2**	**4.4**	**3.5**	**3.3**	**2.9**	**17**	**2.6**	3.0U	**2.8**	**2.7**	**2.7**
Potassium, Total	---	---	**4,080**	**4,150**	**3,700**	**4,220**	**4,690**	**4,910**	**3,970**	**3,920**	**3,840**	**3,500**	**3,700**	**3,760**	**3,590**	**3,720**	**3,560**	**3,540**
Selenium, Total	50 µg/L	100 µg/L	**2.0J**	3.0U	3.0U	**1.7J**	**1.6J**	**1.6J**	3.0 U	3.0 U	3.0 U	3.0U	3.0U	3.0U	1.5U	3.0U	3.0 U	3.0 U
Silver, Total	25 µg/L	50 µg/L	0.40U	0.40U	0.40U	0.40U	0.40U	0.40U	0.40U	0.40U	0.40U	0.40U	0.40U	0.40U	0.40U	0.40U	0.40U	0.40 U
Sodium, Total	---	---	**151,000**	**145,000**	**130,000**	**160,000**	**172,000**	**176,000**	**151,000**	**151,000**	**149,000**	**135,000**	**144,000**	**145,000**	**144,000**	**149,000**	**143,000**	**140,000**
Thallium, Total	---	---	0.40U	0.40U	0.40U	0.40U	0.40U	0.40U	0.40U	0.40U	0.40U	0.40U	0.40U	0.40U	0.40U	0.40U	0.40U	0.40 U
Vanadium, Total	---	---	4.0U	4.0U	4.0U	4.0U	4.0U	**0.69J**	**0.74J**	**2.0J**	4.0 U	**1.0J**	**0.53J**	4.0 U	4.0U	4.0U	4.0U	4.0 U
Zinc, Total	---	---	**22.5**	**25.9**	**28.8**	**19.5**	**23.3**	**91.0**	**27.0**	**22.1**	**25.6**	**89.2J**	**27.1**	**24.5**	**14.8**	**23.6**	**26.9**	**30.4**
Wet Chemistry Parameters																		
Specific Conductivity	--- µmho/cm	--- µmho/cm	**1,300**	**1,200**	**1,100**	**1,300**	**1,400**	**1,300**	**1,300**	**1,300**	**1,200**	**1,200**	**1,200**	**1,200**	**1,200**	**1,100**	**1,100**	**1,100**
pH	---	6.0 - 9.0	**---**	**---**	**---**	**---**	**---**	**---**	**7.61**	**7.78**	**7.07**	**6.32**	**6.24**	**6.60**	**6.92**	**6.27**	**6.52**	**6.35**
Total Organic Carbon	Report	20 mg/L	**26**	**13**	**0.80J**	0.7U	1.0U	1.0U	**0.68J**	**0.61J**	**0.70J**	**0.77J**	**0.75J**	**0.80J**	**0.64J**	**0.63J**	**0.59J**	**0.58J**
Alkalinity	--- mg/L	--- mg/L	**91**	**80**	**84**	**90**	**90**	**85**	**85**	**87**	**87**	**86**	**88**	**86**	**87**	**78**	**88**	**87**
Hardness	--- mg/L	--- mg/L	**270**	**240**	**240**	**260**	**330**	**280**	**260**	**250**	**260**	**250**	**240**	**240**	**230**	**200**	**220**	**210**
Total Suspended Solids	Report	40 mg/L	3.0U	3.0U	3.0U	3.0U	3.0U	3.0U	0.30U	3.0U	3.0U	3.0U	3.0U	3.0U	3.0U	3.0U	**1.2J**	3.0U

Notes:
1. Detected values are in bold.
2. Values exceeding the NJPDES-DSW permit equivalent criteria are highlighted.

µg/L-microgram per liter
mg/L - milligram per liter
U - not detected
J - estimated value
µmho/cm- micromho per centimeter
NA - not analyzed
NJDEP - New Jersey Department of Environmental Protection
NJPDES - New Jersey Pollutant Discharge Elimination System
DSW - Discharge to Surface Water

Table 6-5
Air Performance and Compliance Sampling Summary
Rockaway Borough Superfund Site - East Main/Wall Street Plume - OU2
Rockaway Borough, New Jersey

Sampling Date	VOC	HAPs	Influent Air Concentration GAC 1- INF (ppbv)[1]		Effluent Air Concentration GAC 2- EFF (ppbv)[1]		Molecular Weight (g/mol)	Air Flow Rate (cfm)	Emissions Rate from stack (lb/d)[2,3]	Permit Equivalent Limit (lb/d)	% removal (95% removal required) [3]
Functionality Test - October 21 - 27, 2011[4]											
	Acetone		1,680		3,470		58.1	2,100	1.5555		-
	Benzene	X	<4.0	U	0.58	J	78.1	2,100	0.0003		-
	Carbon disulfide	X	<4.0	U	1.2	J	76.1	2,100	0.0007		-
	Chloromethane	X	<4.0	U	0.7	J	50.5	2,100	0.0003		-
	Ethanol		<10.0	U	4.9	J	46.1	2,100	0.0017		-
	Hexane	X	2.0	J	<0.80	UJ	86.2	2,100	0.0000		-
	Methyl ethyl ketone	X	5.4		31.7	J	72.1	2,100	0.0176		-
	Methyl Isobutyl Ketone	X	3.0	J	4	J	100.2	2,100	0.0031		-
	1,2,4-Trimethylbenzene		<4.0	U	0.4	J	120.2	2,100	0.0004		-
10/24/11	1,3,5-Trimethylbenzene		3.5	J	1.4	J	120.2	2,100	0.0013		-
	2,2,4-Trimethylpentane	X	<4.0	U	2.8	J	114.2	2,100	0.0025		-
	Tertiary Butyl Alcohol		<4.0	U	1	J	74.1	2,100	0.0006		-
	Tetrachloroethylene	X	50.7		<0.16	UJ	165.8	2,100	0.0000	0.03	100
	Tetrahydrofuran		10.4		48.5	J	72.1	2,100	0.0270		-
	Toluene	X	2.0	J	1.3	J	92.1	2,100	0.0009		-
	Trichloroethylene	X	<0.80	U	2.9	J	131.4	2,100	0.0029		-
	m,p-Xylene	X	2.0	J	0.53	J	106.2	2,100	0.0004		-
	Total VOCs		**1,759**		**3,572**				**1.6153**	0.03	none
	Total HAPs		**65**		**46**				**0.0288**	0.03	29.8
	Acetone		NS		856		58.1	2,100	0.3837		-
	Chloromethane	X	NS		0.49	J	50.5	2,100	0.0002		-
	Ethanol		NS		3.5		46.1	2,100	0.0012		-
	Isopropyl Alcohol		NS		2.1		60.1	2,100	0.0010		-
	Methyl ethyl ketone	X	NS		20.1		72.1	2,100	0.0112		-
	Methyl Isobutyl Ketone	X	NS		2.0		100.2	2,100	0.0015		-
	1, 2,4-Trimethyl benzene		NS		0.41	J	120.2	2,100	0.0004		-
10/25/11	1,3,5-Trimethylbenzene		NS		1.4		120.2	2,100	0.0013		-
	Tetrachloroethylene	X	NS		<0.16	U	165.8	2,100	0.0000	0.03	-
	Tetrahydrofuran		NS		32.3		72.1	2,100	0.0180		-
	Toluene	X	NS		0.90		92.1	2,100	0.0006		-
	Trichloroethylene	X	NS		2.3		131.4	2,100	0.0023		-
	m,p-Xylene	X	NS		0.47	J	106.2	2,100	0.0004		-
	Total VOCs				**922**				**0.4219**	0.03	
	Total HAPs				**26**				**0.0163**	0.03	-
	Acetone		NS		34,300		58.1	2,100	15.3752		-
	Chloromethane	X	NS		0.71	J	50.5	2,100	0.0003		-
	Ethanol		NS		30.3		46.1	2,100	0.0108		-
	Heptane		NS		1.1		100.2	2,100	0.0009		-
	Hexane	X	NS		1.2		86.2	2,100	0.0008		-
	Isopropyl Alcohol		NS		30.7		60.1	2,100	0.0142		-
	Methyl ethyl ketone	X	NS		64.3		72.1	2,100	0.0358		-
	Methyl Isobutyl Ketone	X	NS		15		100.2	2,100	0.0116		-
10/26/11	1, 2,4-Trimethyl benzene		NS		1.1		120.2	2,100	0.0010		-
	1,3,5-Trimethylbenzene		NS		3.9		120.2	2,100	0.0036		-
	Tetrachloroethylene	X	NS		<0.16	U	165.8	2,100	0.0000	0.03	-
	Tetrahydrofuran		NS		98.9		72.1	2,100	0.0550		-
	Toluene	X	NS		2.7		92.1	2,100	0.0019		-
	m,p-Xylene	X	NS		0.93		106.2	2,100	0.0008		-
	o-Xylene	X	NS		0.42	J	106.2	2,100	0.0003		-
	Total VOCs				**34,551**				**15.5122**	0.03	
	Total HAPs				**85**				**0.0515**	0.03	-

Table 6-5
Air Performance and Compliance Sampling Summary
Rockaway Borough Superfund Site - East Main/Wall Street Plume - OU2
Rockaway Borough, New Jersey

Sampling Date	VOC	HAPs	Influent Air Concentration GAC 1- INF (ppbv)[1]		Effluent Air Concentration GAC 2- EFF (ppbv)[1]		Molecular Weight (g/mol)	Air Flow Rate (cfm)	Emissions Rate from stack (lb/d)[2,3]	Permit Equivalent Limit (lb/d)	% removal (95% removal required)[3]
10/26/11	Acetone		NS		12,300		58.1	2,100	5.5136		-
	Benzene	X	NS		2.6		78.1	2,100	0.0016		-
	1, 2,4-Trimethyl benzene		NS		0.95	J	120.2	2,100	0.0009		-
	1,3,5-Trimethylbenzene		NS		3.9		120.2	2,100	0.0036		-
	2,2,4-Trimethylpentane	X	NS		2.0		114.2	2,100	0.0018		-
	Tertiary Butyl Alcohol		NS		2.3		74.1	2,100	0.0013		-
	Tetrachloroethylene	X	NS		<0.29	U	165.8	2,100	0.0000	0.03	-
	Tetrahydrofuran		NS		40.5		72.1	2,100	0.0225		-
	Toluene	X	NS		2.0		92.1	2,100	0.0014		-
	m,p-Xylene	X	NS		1.0	J	106.2	2,100	0.0008		-
	Total VOCs				**12,355**				**5.5475**	0.03	
	Total HAPs				**8**				**0.0056**	0.03	-
10/27/11	Acetone		NS		7,960		58.1	2,100	3.5681		-
	Ethanol		NS		6.6		46.1	2,100	0.0023		-
	Methyl ethyl ketone	X	NS		2.4		72.1	2,100	0.0013		-
	Methyl Isobutyl Ketone	X	NS		0.64	J	100.2	2,100	0.0005		-
	1,3,5-Trimethylbenzene		NS		0.52	J	120.2	2,100	0.0005		-
	Tetrachloroethylene	X	NS		<0.16	U	165.8	2,100	0.0000	0.03	-
	Tetrahydrofuran		NS		5.2		72.1	2,100	0.0029		-
	Toluene	X	NS		0.39	J	92.1	2,100	0.0003		-
	Total VOCs				**7,976**				**3.5760**	0.03	
	Total HAPs				**3**				**0.0021**	0.03	-
10/27/11	Acetone		NS		2,650		58.1	2,100	1.1879		-
	Ethanol		NS		6.0		46.1	2,100	0.0021		-
	Methyl ethyl ketone	X	NS		1.6		72.1	2,100	0.0009		-
	1,3,5-Trimethylbenzene		NS		0.49	J	120.2	2,100	0.0005		-
	Tetrachloroethylene	X	NS		<0.16	U	165.8	2,100	0.0000	0.03	-
	Tetrahydrofuran		NS		4.9		72.1	2,100	0.0027		-
	Total VOCs				**2,663**				**1.1941**	0.03	
	Total HAPs				**2**				**0.0009**	0.03	**-**
14 Day Test - November 6 - 16, 2011											
11/6/11	Acetone		898		844		58.1	2,100	0.3783		-
	Chloromethane	X	0.62	J	0.57	J	50.5	2,100	0.0002		-
	Dichlorodifluoromethane		0.51	J	<0.8	U	120.9	2,100	0.0000		-
	Ethanol		4.4		4.8		46.1	2,100	0.0017		-
	Ethyl Acetate		<0.8	U	0.62	J	88.1	2,100	0.0004		-
	Isopropyl Alcohol		1.0		<0.8	U	60.1	2,100	0.0000		-
	Methyl ethyl ketone	X	0.96		1.3		72.1	2,100	0.0007		-
	Propylene		<2.0	U	0.99	J	42.1	2,100	0.0003		-
	1,3,5-Trimethylbenzene		0.61	J	<0.8	U	120.2	2,100	0.0000		-
	Tetrachloroethylene	X	555		<0.16	U	165.8	2,100	0.0000	0.03	100
	Tetrahydrofuran		1.4		2.3		72.1	2,100	0.0013		-
	Trichloroethylene	X	3.3		<0.16	U	131.4	2,100	0.0000		-
	Total VOCs		**1,466**		**855**				**0.3830**	0.03	41.7
	Total HAPs		**560**		**2**				**0.0009**	0.03	99.7

Table 6-5
Air Performance and Compliance Sampling Summary
Rockaway Borough Superfund Site - East Main/Wall Street Plume - OU2
Rockaway Borough, New Jersey

Sampling Date	VOC	HAPs	Influent Air Concentration GAC 1- INF (ppbv)[1]		Effluent Air Concentration GAC 2- EFF (ppbv)[1]		Molecular Weight (g/mol)	Air Flow Rate (cfm)	Emissions Rate from stack (lb/d)[2,3]	Permit Equivalent Limit (lb/d)	% removal (95% removal required) [3]
11/7/11	Acetone		3,060		1,120		58.1	2,100	0.5020		-
	Chloromethane	X	0.73	J	0.66	J	50.5	2,100	0.0003		-
	Dichlorodifluoromethane		0.54	J	<0.8	U	120.9	2,100	0.0000		-
	cis-1,2-Dichloroethylene		14.9		<0.8	U	96.9	2,100	0.0000		-
	Ethanol		6.8		5.2		46.1	2,100	0.0018		-
	Isopropyl Alcohol		1.3		<0.8	U	60.1	2,100	0.0000		-
	Methylene chloride	X	1.7		<0.8	U	84.9	2,100	0.0000		-
	Methyl ethyl ketone	X	2.5		1.3		72.1	2,100	0.0000		-
	Methyl Isobutyl Ketone	X	0.52	J	<0.8	U	100.2	2,100	0.0000		-
	Propylene		<2.0	U	1.8	J	42.1	2,100	0.0006		-
	1, 2,4-Trimethyl benzene		0.41	J	<0.8	U	120.2	2,100	0.0000		-
	1,3,5-Trimethylbenzene		0.7	J	<0.8	U	120.2	2,100	0.0000		-
	Tertiary Butyl Alcohol		0.39	J	<0.8	U	74.1	2,100	0.0000		-
	Tetrachloroethylene	X	286		<0.16	U	165.8	2,100	0.0000	0.03	100
	Tetrahydrofuran		1.4		2.3		72.1	2,100	0.0013		-
	Toluene	X	0.55	J	<0.8	U	92.1	2,100	0.0000		-
	Trichloroethylene	X	3.0		<0.8	U	131.4	2,100	0.0000		-
	m,p-Xylene	X	0.64	J	<0.8	U	106.2	2,100	0.0000		-
	Total VOCs		**3,382**		**1,131**				**0.5060**	0.03	66.6
	Total HAPs		**296**		**2**				**0.0003**	0.03	99.3
11/9/11	Acetone		4,420		7,660		58.1	2,050	3.3519		-
	Benzene	X	1.2		0.46	J	78.1	2,050	0.0003		-
	Chloromethane	X	0.79	J	0.7	J	50.5	2,050	0.0003		-
	cis-1,2-Dichloroethylene		12.2		<0.8	U	96.9	2,050	0.0000		-
	Ethanol		7.6		<2.0	U	46.1	2,050	0.0000		-
	Hexane	X	1.8		<0.8	U	86.2	2,050	0.0000		-
	Isopropyl Alcohol		1.6		<0.8	U	60.1	2,050	0.0000		-
	Methyl ethyl ketone	X	1.6		2.0		72.1	2,050	0.0011		-
	Methyl Isobutyl Ketone	X	<0.8	U	1.3		100.2	2,050	0.0010		-
	Propylene		<2.0	U	4.0		42.1	2,050	0.0013		-
	1, 2,4-Trimethyl benzene		0.67	J	<0.8	U	120.2	2,050	0.0000		-
	1,3,5-Trimethylbenzene		1.2		0.62	J	120.2	2,050	0.0006		-
	2,2,4-Trimethylpentane	X	0.68	J	<0.8	U	114.2	2,050	0.0000		-
	Tetrachloroethylene	X	267		<0.16	U	165.8	2,050	0.0000	0.03	100
	Tetrahydrofuran		1.4		2.7		72.1	2,050	0.0015		-
	Toluene	X	2.7		0.25	J	92.1	2,050	0.0002		-
	Trichloroethylene	X	2.5		<0.16	U	131.4	2,050	0.0000		-
	m,p-Xylene	X	1.0		<0.8	U	106.2	2,050	0.0000		-
	o-Xylene	X	0.39	J	<0.8	U	106.2	2,050	0.0000		-
	Total VOCs		**4,724**		**7,672**				**3.3580**	0.03	none
	Total HAPs		**280**		**5**				**0.0028**	0.03	98.3
11/12/11	Acetone		2,420		902		58.1	2,200	0.4236		-
	Chloromethane	X	0.53	J	<0.8	U	50.5	2,200	0.0000		-
	Dichlorodifluoromethane		0.56	J	0.58	J	120.9	2,200	0.0006		-
	cis-1,2-Dichloroethylene		2.1		<0.8	U	96.9	2,200	0.0000		-
	Ethanol		3.1		3.6		46.1	2,200	0.0013		-
	Methyl ethyl ketone	X	<0.8	U	0.82		72.1	2,200	0.0005		-
	Propylene		0.96	J	<2.0	U	42.1	2,200	0.0000		-
	Tetrachloroethylene	X	125		<0.16	U	165.8	2,200	0.0000	0.03	100
	Tetrahydrofuran		0.91		1.1		72.1	2,200	0.0006		-
	Toluene	X	0.42	J	<0.8	U	92.1	2,200	0.0000		-
	Trichloroethylene	X	0.79		<0.16	U	131.4	2,200	0.0000		-
	Total VOCs		**2,554**		**908**				**0.4266**	0.03	64.4
	Total HAPs		**127**		**1**				**0.0005**	0.03	99.4

Table 6-5
Air Performance and Compliance Sampling Summary
Rockaway Borough Superfund Site - East Main/Wall Street Plume - OU2
Rockaway Borough, New Jersey

Sampling Date	VOC	HAPs	Influent Air Concentration GAC 1- INF (ppbv)[1]		Effluent Air Concentration GAC 2- EFF (ppbv)[1]		Molecular Weight (g/mol)	Air Flow Rate (cfm)	Emissions Rate from stack (lb/d)[2,3]	Permit Equivalent Limit (lb/d)	% removal (95% removal required) [3]
11/16/11	Acetone		1,960		771		58.1	2,150	0.3538		-
	Chloromethane	X	0.68	J	0.63	J	50.5	2,150	0.0003		-
	Dichlorodifluoromethane		0.55	J	0.61	J	120.9	2,150	0.0006		-
	cis-1,2-Dichloroethylene		2.2		<0.8	U	96.9	2,150	0.0000		-
	Ethanol		3.2		2.8		46.1	2,150	0.0010		-
	Ethylbenzene	X	4.6		<0.8	U	106.2	2,150	0.0000		-
	Methyl ethyl ketone	X	0.73	J	1.0		72.1	2,150	0.0006		-
	Propylene		0.78	J	1.2	J	42.1	2,150	0.0004		-
	Tetrachloroethylene	X	704		<0.16	U	165.8	2,150	0.0000	0.03	100
	Tetrahydrofuran		0.57	J	1.2		72.1	2,150	0.0007		-
	Toluene	X	0.52	J	<0.8	U	92.1	2,150	0.0000		-
	Trichloroethylene	X	0.81		<0.16	U	131.4	2,150	0.0000		-
	m,p-Xylene	X	21.1		0.48	J	106.2	2,150	0.0004		-
	o-Xylene	X	6.6		<0.8	U	106.2	2,150	0.0000		-
	Total VOCs		**2,706**		**779**				**0.3577**	0.03	71.2
	Total HAPs		**739**		**2**				**0.0012**	0.03	99.7
48 Hour Test - November 18 - 19, 2011											
11/18/11	Acetone		965		891		58.1	2,150	0.4089		-
	Benzene	X	<2.2	U	0.98		78.1	2,150	0.0006		-
	cis-1,2-Dichloroethylene		9.6		<0.8	U	96.9	2,150	0.0000		-
	Ethanol		9.1		4.3		46.1	2,150	0.0016		-
	Ethylbenzene	X	3.1		<0.8	U	106.2	2,150	0.0000		-
	Ethyl Acetate		6.0		23.9		88.1	2,150	0.0166		-
	Methyl ethyl ketone	X	<2.2	U	0.71	J	72.1	2,150	0.0004		-
	Tetrachloroethylene	X	374		<0.16	U	165.8	2,150	0.0000	0.03	100
	Tetrahydrofuran		<2.2	U	0.83		72.1	2,150	0.0005		-
	Toluene	X	<2.2	U	0.7	J	92.1	2,150	0.0005		-
	Trichloroethylene	X	1.9		<0.16	U	131.4	2,150	0.0000		-
	m,p-Xylene	X	14.1		<0.8	U	106.2	2,150	0.0000		-
	o-Xylene	X	4.2		<0.8	U	106.2	2,150	0.0000		-
	Total VOCs		**1,387**		**922**				**0.4291**	0.03	33.5
	Total HAPs		**397**		**2**				**0.0015**	0.03	99.4

Notes:

1. Data obtained via TO-15 analysis. Parameters not included in the table had non-detect sample results.
2. The emissions rate was calculated using the formula:
   Effluent Air Concentration (ppbv) x Molecular Weight (g/mol) x Air Flow Rate (cfm) x (1440 min/day) x (1 lb/453.6 g) x (1 mol/24.47 L at STP) x (1 L/0.0353 cf) x 1/109
3. Non-detect results were assumed to have a value of 0 ppbv.
4. Flow rates for the functionality testing are estimated.

Acronyms:

VOC - volatile organic compound
GAC - granular activated carbon unit
INF - influent
EFF - effluent
ppbv - parts per billion by volume
g - gram
mol - mole
J - results is estimated
U - results is non-detect
min - minute
L - liter
STP - standard temperature and pressure
HAP - hazardous air pollutant
cf - cubic feet
cfm - cubic feet per minute
OU - operable unit
NS - not sampled

Table 7-1
Groundwater Treatment System Monitoring Schedule
Rockaway Borough Superfund Site – East Main/Wall Street Plume – OU2
Rockaway Borough, New Jersey

Sample Task	Location	Sample ID Number	Analytical Group	Number of Sampling Locations	Number of Field Duplicates[2]	Number of MS/MSD Pairs[3]	Number of Trip Blanks[4]	Number of Field (Rinsate) Blanks[5]	Total Number of Samples to Lab
Weekly Monitoring Requirements									
Weekly Vapor	GWTF-VP	VP-INF-1	VOCs via PID	1	NA	NA	NA	NA	NA
Weekly Vapor	GWTF-VP	VP-GAC-1	VOCs via PID	1	NA	NA	NA	NA	NA
Weekly Vapor	GWTF-VP	VP-DIS-1	VOCs via PID	1	NA	NA	NA	NA	NA
Monthly Monitoring Requirements									
Monthly Influent	GWTF	LP-INF-1	VOCs (short list) [1]	1	0	0	1	0	2
Monthly Effluent	GWTF	LP-EFF-1	VOCs (short list) [1]	1	0	0	0	0	1
Monthly Effluent	GWTF	LP-EFF-1	Metals (Nickel/Zinc Only)	1	1	0	NA	0	2
Monthly Effluent	GWTF	LP-EFF-1	TSS	1	0	0	NA	0	1
Monthly Effluent	GWTF	LP-EFF-1	TOC	1	0	0	NA	0	1
Monthly Effluent	GWTF	LP-EFF-1	pH	1	0	0	NA	0	0
Monthly Vapor	GWTF-VP	VP-INF-1	VOCs – TO15	1	0	0	0	0	1
Monthly Vapor	GWTF-VP	VP-GAC-1	VOCs – TO15	1	0	0	0	0	1
Monthly Vapor	GWTF-VP	VP-DIS-1	VOCs – TO15	1	0	0	0	0	1
Quarterly Monitoring Requirements									
Quarterly Influent	GWTF	LP-INF-1	TCL VOCs	1	1	1	1	0	5
Quarterly Effluent	GWTF	LP-EFF-1	Whole Effluent Toxicity	1	0	0	NA	0	1
Quarterly Groundwater	Monitoring / Extraction Wells	See Note 6	TCL VOCs, water levels, water quality parameters [7]	48	5	2	2	0	57
Annual Monitoring Requirements									
Annual Effluent	GWTF	LP-EFF-1	VOCs (Long List) [1]	1	0	0	0	0	1
Annual Effluent	GWTF	LP-EFF-1	SVOC	1	1	0	NA	0	2
Annual Effluent	GWTF	LP-EFF-1	TAL Metals	1	1	1	NA	0	4
Annual Effluent	GWTF	LP-EFF-1	Cyanide	1	1	1	NA	0	4

Table 7-1
Groundwater Treatment System Monitoring Schedule
Rockaway Borough Superfund Site – East Main/Wall Street Plume – OU2
Rockaway Borough, New Jersey

Sample Task	Location	Sample ID Number	Analytical Group	Number of Sampling Locations	Number of Field Duplicates[2]	Number of MS/MSD Pairs[3]	Number of Trip Blanks[4]	Number of Field (Rinsate) Blanks[5]	Total Number of Samples to Lab
Annual Effluent	GWTF	LP-EFF-1	Pesticides	1	0	0	0	0	1
Annual Effluent	GWTF	LP-EFF-1	PCBs	1	1	1	NA	0	4
Annual Effluent	GWTF	LP-EFF-1	Dioxin	1	1	0	NA	0	2

Notes:
1. Long list = EPA method 8260B. Short list = tetrachloroethene, trichloroethene, and 1,1-dichloroethene.
2. Field duplicates are collected at a frequency rate of 10 percent.
3. Matrix spike pairs are collected at a frequency rate of 5 percent.
4. A trip blank will accompany all VOC field samples in one cooler per sampling event.
5. Rinsate blanks will not be collected during this project.
6. Samples will be collected from the following wells: MW-1A, RBW-01, RBW-02, RBW-04, RBW-06, RBW-08A, RBW-09, RBW-010, RBW-011, RBW-012, RBW-013, RBW-015, RBW-022S, SAI-1 through SAI-4, MW1-D, MW1-R, MW2-D, MW3-D, PZ-1 through PZ-12 (all intervals), EW-5A, EW-6, EW-8, EW-9 and EW-10.
7. Water quality parameters include dissolved oxygen, temperature, conductivity, pH, turbidity, and oxidation reduction potential.

Acronyms:
GWTF – groundwater treatment facility
INF - influent
EFF - effluent
GAC – granular activated carbon unit
DIS - discharge
NA – not applicable
ID - identification
VOC – volatile organic compound
SVOC – semi-volatile organic compound
PCB – polychlorinated biphenyl
TCL – target compound list
TAL – target analyte list
PID – photo-ionization detector
VP - vapor
MS – matrix spike
MSD – matrix spike duplicate

Table 8-1
Summary of Project Costs
Rockaway Borough Superfund Site - East Main/Wall Street Plume - OU2
Rockaway Borough, New Jersey

	Cost at Completion	
USACE [1]		$1,052,738
RA Contractor	Base	$7,998,569
	Total Modifications[2]	$52,698
	RA Contractor Cost	$8,051,267
Total:		**$9,104,005**

Notes:
1. USACE cost Includes NY District Construction Oversight, Project Management, QA and Safety; Kansas City Technical Management, and Contracting; GSA Vehicle; and Management & Support (M&S) Fee.
2. Modifications and contractor change requests are listed in Table 8-2.

Table 8-2
Contractor Change Requests
Rockaway Borough Superfund Site - East Main/Wall Street Plume - OU2
Rockaway Borough, New Jersey

CCR Number	Description	Value Change
CCR-001	Additional permitting requirements (resubmit NJDEP Discharge to Surface Water Permit, Air Quality Permit Equivalent, and Safe Drinking Water Act Permit Equivalent)	$39,397
CCR-002	Additional concrete gravity wall removal located under pump house slab	$13,301
Total		$52,698

Table 10-1
Project Contact List
Rockaway Borough Superfund Site - East Main/Wall Street Plume - OU2
Rockaway Borough, New Jersey

Name	Company	Title	Phone Number	E-mail Address
Bob McKnight	EPA	Section Chief	212-637-4378	McKnight.Bob@epa.gov
Brian Quinn	EPA	Remedial Project Manager	212-637-4381	Quinn.Brian@epa.gov
Tom Cimarelli	USACE New York	Project Manager	917-790-8233	Thomas.A.Cimarelli@usace.army.mil
Gene Urbanik	USACE New York	Area Engineer, Alternate ACO	732-846-5830	Gene.R.Urbanik@usace.army.mil
Neal Kolb	USACE New York	Resident Engineer, ACO	732-846-5830	Neal.F.Kolb@usace.army.mil
Michael Johnson	USACE New York	COR, Team Leader	732-846-5830	Michael.C.Johnson@usace.army.mil
Kevin O'Brien	USACE New York	Project Engineer	973-627-2013	Kevin.P.OBrien@usace.army.mil
Kam Chan	USACE New York	Project Engineer	201-226-6643	KamYin.Chan@usace.army.mil
Ronny Hwee	USACE New York	Project Engineer	732-846-5830	Ronny.K.Hwee@usace.army.mil
Saqib Khan	USACE Kansas City	Project Manager	816-389-3239	Saqib.Khan@usace.army.mil
Francis Bales	USACE Kansas City	Professional Engineer	816-389-3591	Francis.E.Bales@usace.army.mil
Charles Williams	USACE Kansas City	Project Hydrogeologist	816-389-3575	Charles.Williams@usace.army.mil
Brad Trost	USACE Kansas City	Engineer	816-389-2326	Bradley.A.Trost@usace.army.mil
David Bettendorf	CAPE	Project Manager/General Manager	443-276-1994	dbettendorf@cape-inc.com
Paul Ferroni	CAPE	Assistant Project Manager	610-470-1189	pferroni@cape-inc.com
Eric Lynch	CAPE	CQCSM	484-467-7232	elynch@cape-inc.com
Tom Bykow	CAPE	Construction Manager	908-307-2500	tbykow@cape-inc.com
Frank McConnell	CAPE	Site Superintendent	304-812-3234	fmcconnell@cape-inc.com
Ken Beatty	CAPE	SSHO	770-908-7200	kbeatty@cape-inc.com
Michael Lamon	CAPE	Project Engineer	678-287-1356	mlamon@cape-inc.com
Kershu Tan	CDM Smith	Project Manager	732-590-4692	TanK@cdmsmith.com
Michael Popper	CDM Smith	Project Technical Manager	732-590-4661	PopperM@cdmsmith.com
Matt Jerue	CTI	Project Manager	248-486-5100	mjerue@cticompanies.com
Jamie Dickson	CTI	Senior Process Engineer	920-560-1820	jdickson@cticompanies.com
Cristopher Winkeljohn	CTI	Program Manager	816-841-7802	cwinkeljohn@cticompanies.com

Acronyms:
ACO - Administrative Contracting Officer
CQCSM - Construction Quality Control Service Manager
EPA - Environmental Protection Agency
SSHO - Site Safety and Health Officer
USACE - United States Army Corps of Engineers

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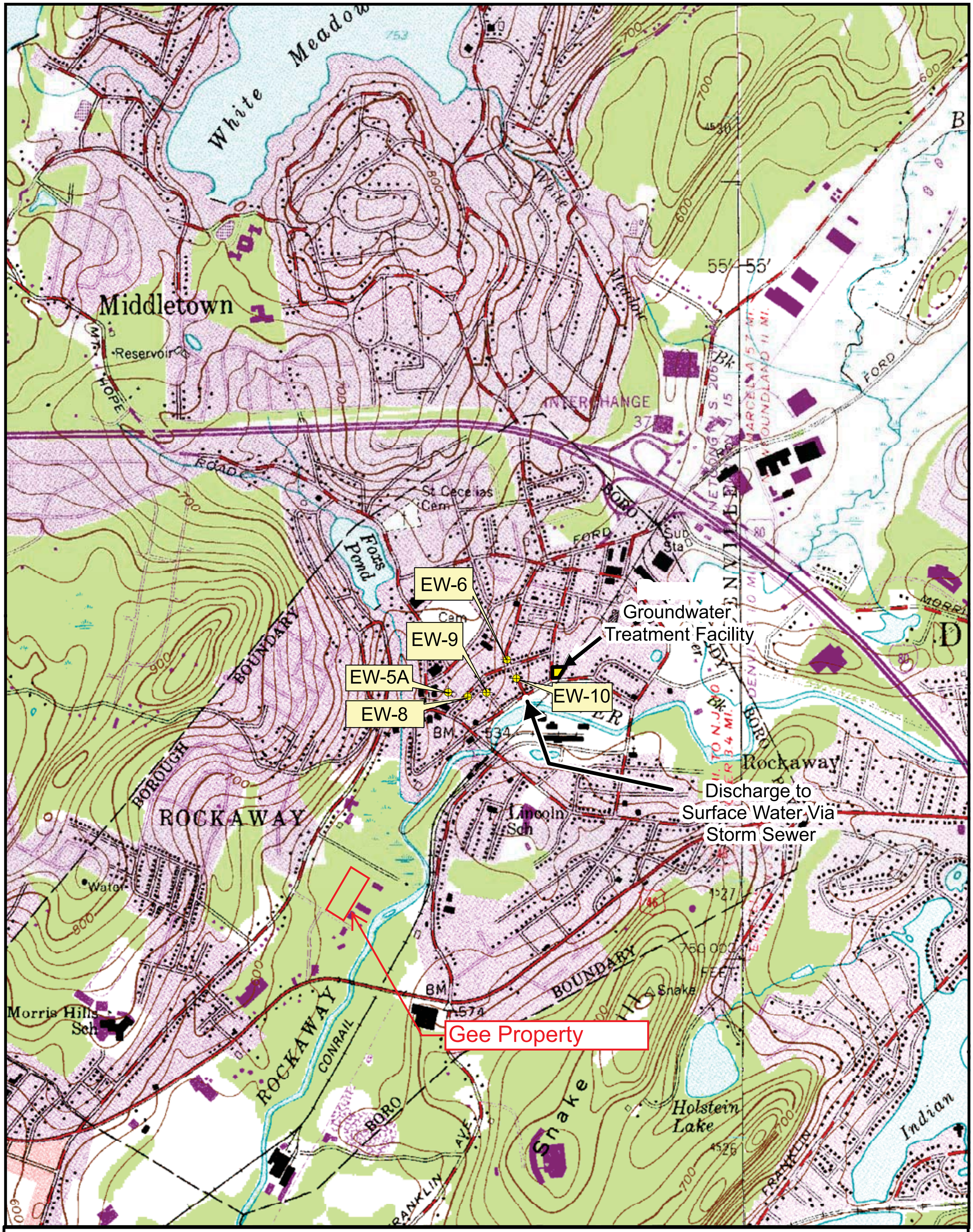


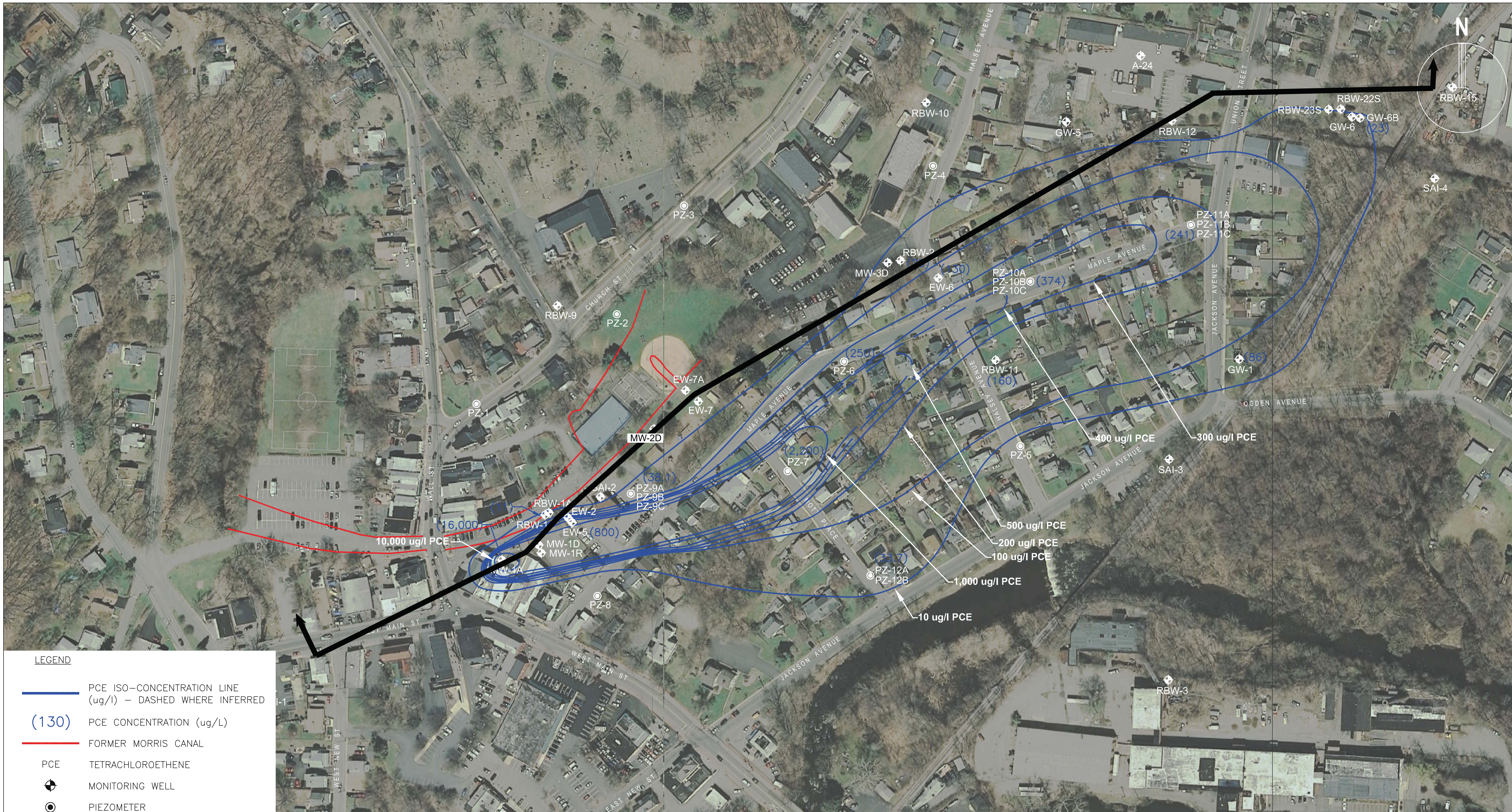
USGS 7.5 Minute Topography Quadrangles maps:
Boonton and Dover, NJ

EW = Extraction Well Location

N

0 0.25 0.5 1 Miles

Figure 1-1
Site Location Map
Rockaway Borough Superfund Site
East Main/ Wall Street Plume - OU2
Rockaway Borough, New Jersey



LEGEND

	PCE ISO–CONCENTRATION LINE (ug/l) – DASHED WHERE INFERRED
(130)	PCE CONCENTRATION (ug/L)
	FORMER MORRIS CANAL
PCE	TETRACHLOROETHENE
	MONITORING WELL
	PIEZOMETER
(ug/l)	MICROGRAM PER LITER

200' 100' 0 200'

Source: HDR/O'Brien & Gere Final Pre-Design Investigation Report, May 2010

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Note: For cross section, see Figure 2-2.

Figure 2-1
Aerial Site Plan
Rockaway Borough Superfund Site
East Main/Wall Street Plume - OU2
Rockaway Borough, New Jersey

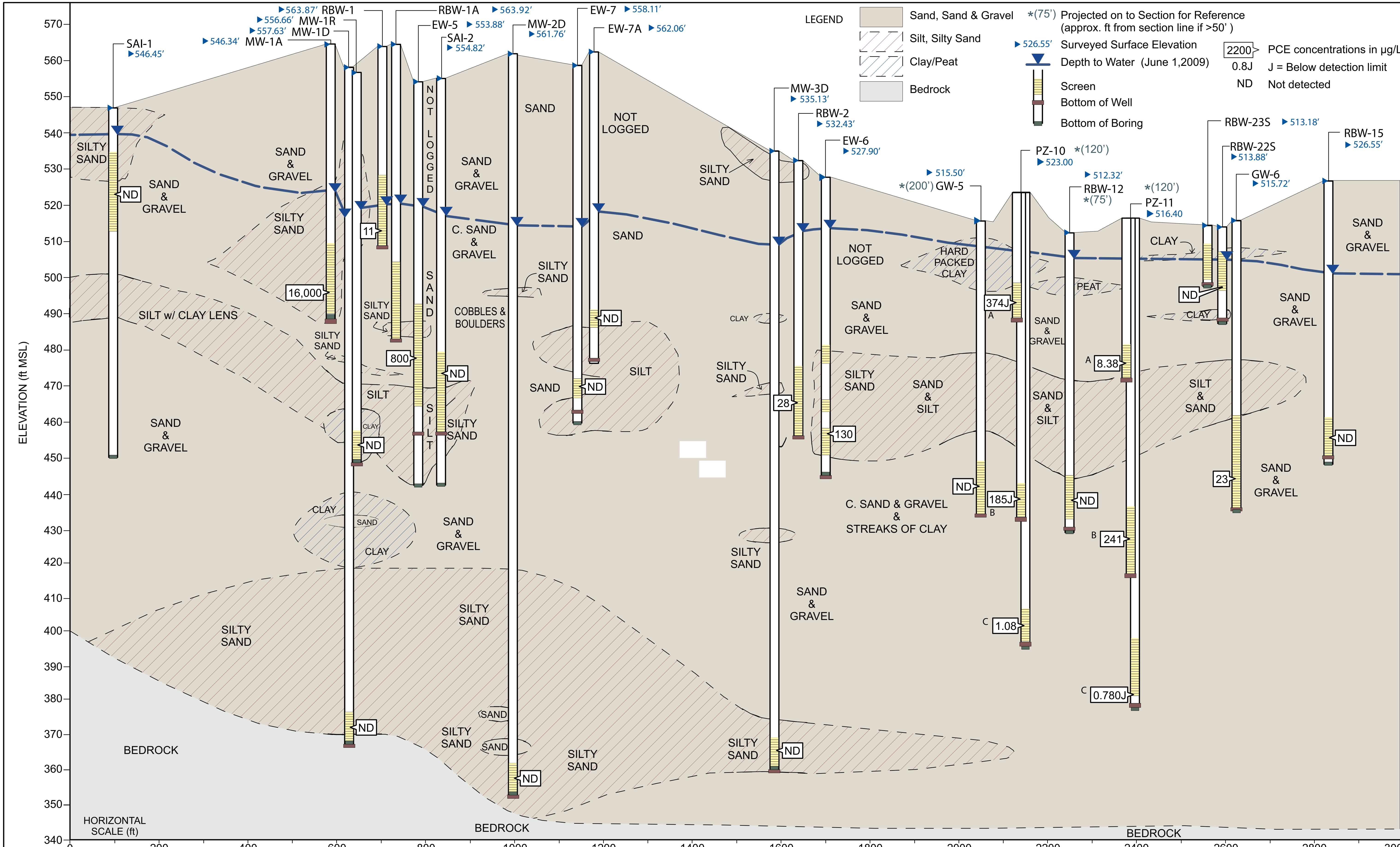
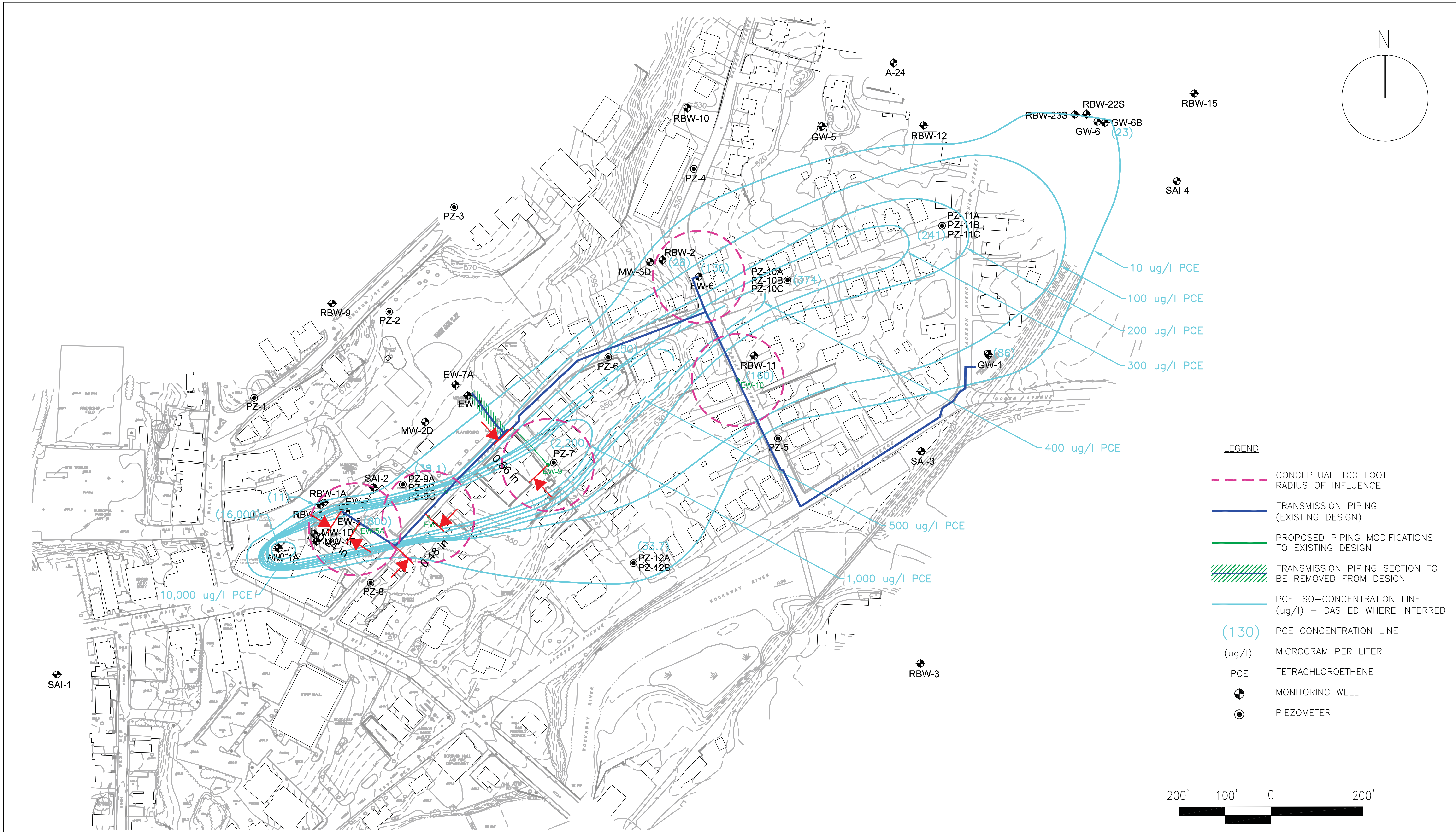


Figure 2-2
Geologic Cross Section
Rockaway Borough Superfund Site - East Main/Wall Street Plume - OU2

Source: HDR/O'Brien & Gere Final Pre-design Investigation Report, May 2010



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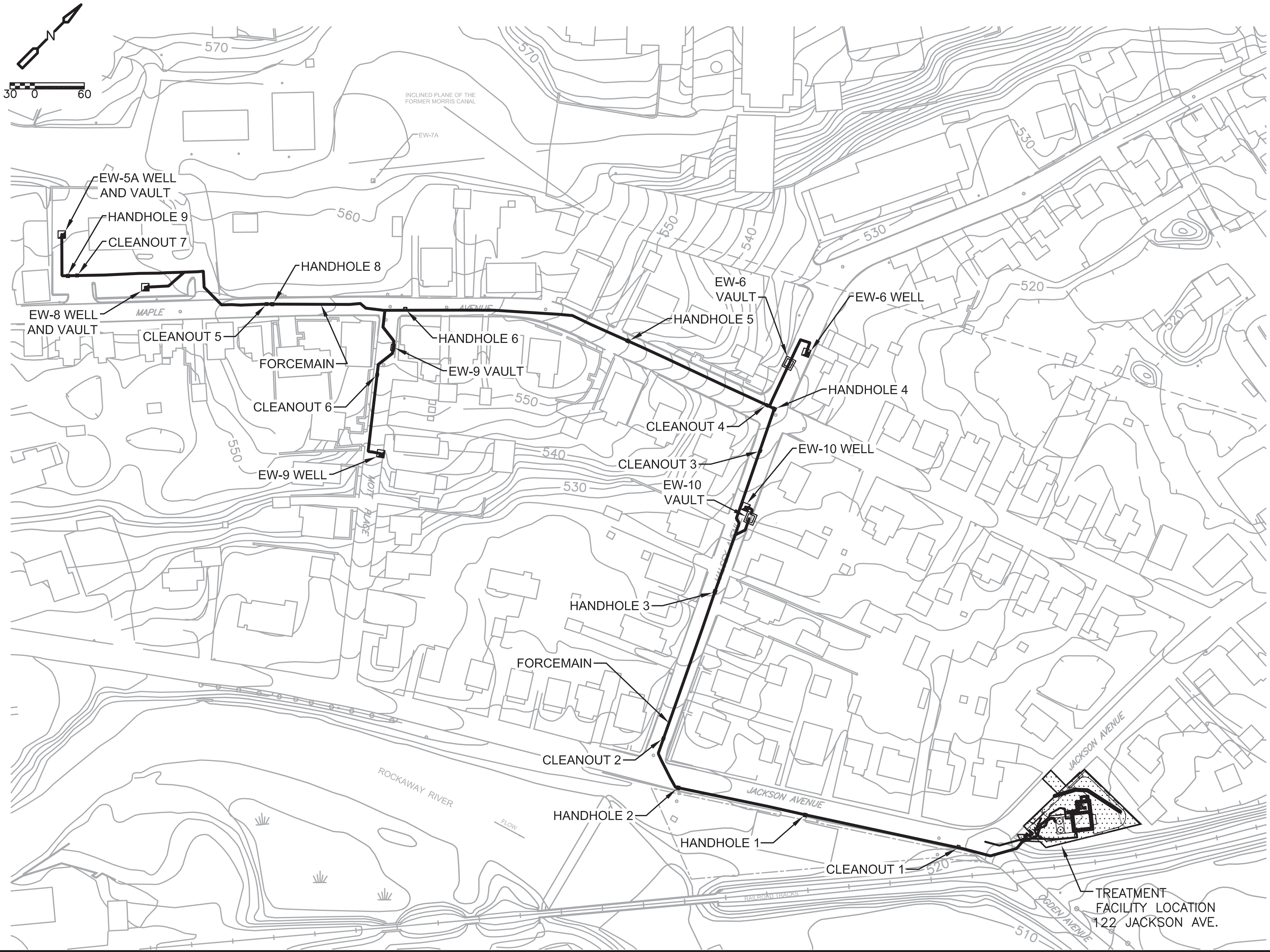
Source: HDR/O'Brien & Gere Final Pre-design Investigation Report, May 2010

Figure 2-3
Conceptual Realignment of Extraction Well Network and Transmission Piping
Rockaway Borough Superfund Site - East Main/Wall Street Plume - OU2
Rockaway Borough, New Jersey



LEGEND

NEW FORCE MAIN LINE

NEW GROUNDWATER EXTRACTION WELL

APPROXIMATE LIMITS OF DESIGN PACKAGE

NOTES

1. DRAWINGS ARE BASED ON SURVEY PREPARED BY STEWART SURVEYING & ENGINEERING LLC DATED AUGUST 2004 AND JULY 2005 AND LAN ASSOCIATES DATED AUGUST 2007 AND SEPTEMBER 2011.

2. HORIZONTAL COORDINATE SYSTEM IS NEW JERSEY STATE PLANE NAD27. VERTICAL COORDINATE SYSTEM IS NGVD 1929.

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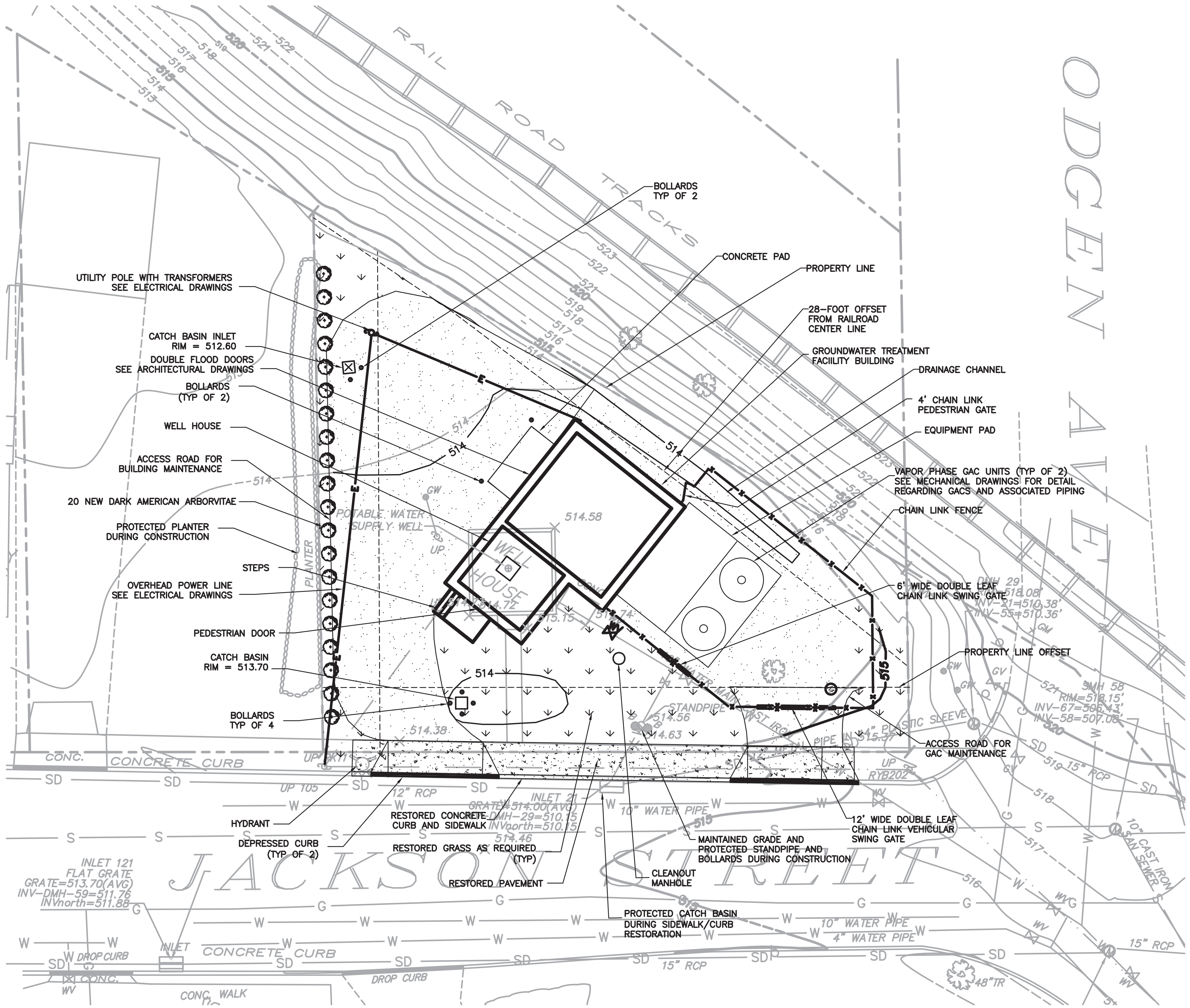
FIGURE 2–4
SITE MAP
ROCKAWAY BOROUGH SUPERFUND SITE – EAST MAIN/WALL STREET PLUME – OU2
ROCKAWAY BOROUGH, NEW JERSEY



NOTES

1. DRAWINGS ARE BASED ON SURVEY PREPARED BY STEWART SURVEYING & ENGINEERING LLC DATED AUGUST 2004 AND JULY 2005 AND LAN ASSOCIATES AUGUST 2007 AND SEPTEMBER 2011.

2. HORIZONTAL COORDINATE SYSTEM IS NEW JERSEY STATE PLANE NAD27. VERTICAL COORDINATE SYSTEM IS NGVD 1929.

3. GREY FEATURES INDICATE EXISTING SITE FEATURES THAT EXISTED PRIOR TO THE CONSTRUCTION WORK. BLACK FEATURES INDICATE WORK PERFORMED AS PART OF THE RA CONSTRUCTION.

LEGEND

- FENCE LINE
- POWER POLE
- MONITORING WELL
- SD — STORM DRAIN LINE
- G — GAS LINE
- OE — OVERHEAD ELECTRICAL LINE
- SS — SANITARY SEWER LINE
- W — WATER LINE
- MANHOLE
- CATCH BASIN
- HYDRANT
- TREE
- WV — WATER VALVE
- GV — GAS VALVE
- GW — GUY WIRE
- SEV — SEWER CLEANOUT
- DEPRESSED CURB
- E — OVERHEAD ELECTRICAL
- 514 — PROPOSED INTERMEDIATE CONTOUR
- 515 — PROPOSED INDEX CONTOUR
- WV — NEW WATER VALVE BOX
- GRASS
- CRUSHED STONE ACCESS ROAD/PARKING AREA
- CONCRETE SIDEWALK
- MANHOLE
- X — FENCE
- BOLLARD
- CATCH BASIN
- HEDGE

SCALE

5 0 10

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FIGURE 2–5
GWTF SITE PLAN
ROCKAWAY BOROUGH SUPERFUND SITE – EAST MAIN/WALL STREET PLUME – OU2
ROCKAWAY BOROUGH, NEW JERSEY

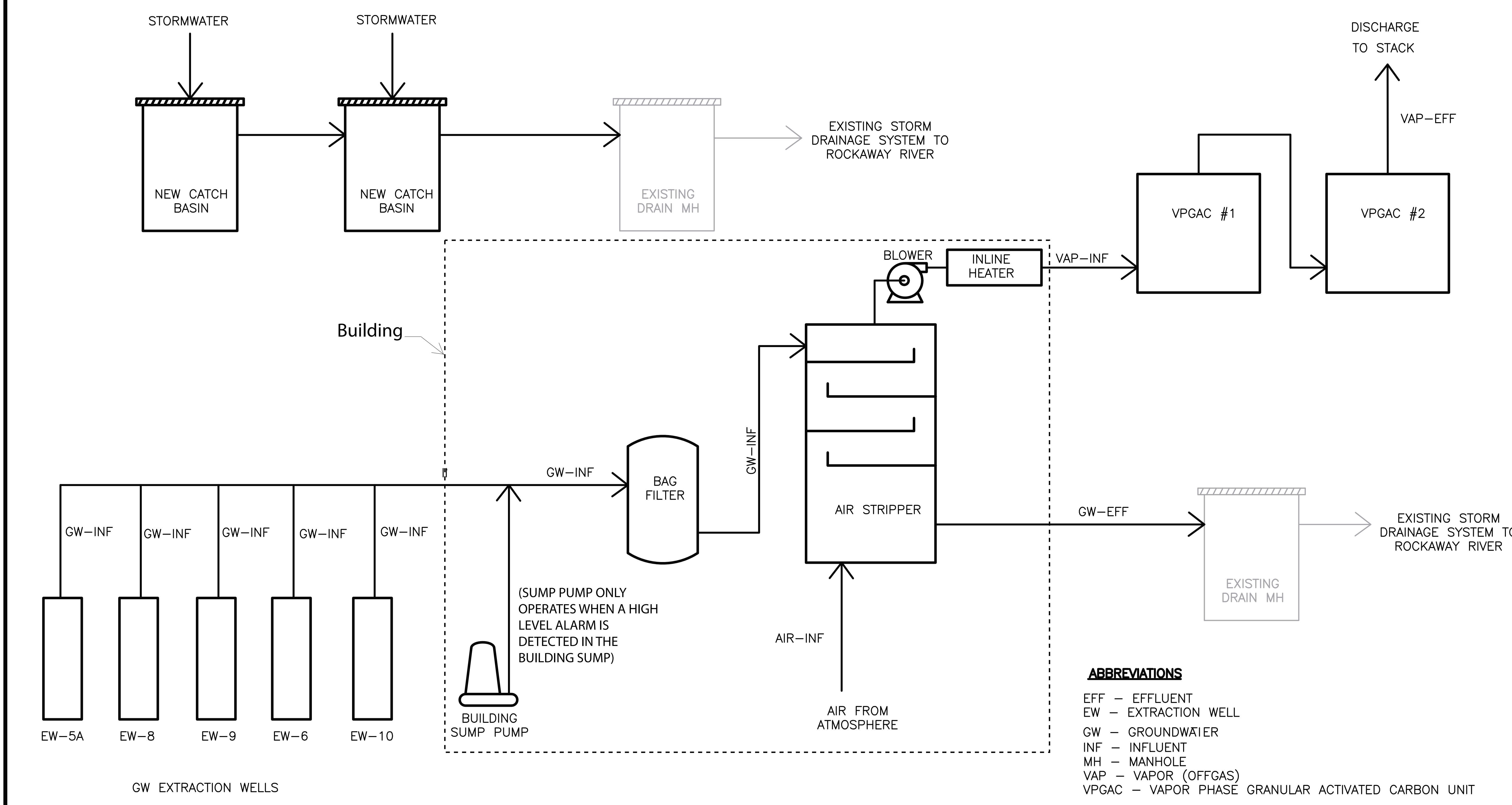

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Figure 2-6
Groundwater Treatment Facility Schematic Line Diagram
Rockaway Borough Superfund Site - East Main/Wall Street Plume - OU2
Rockaway Borough, New Jersey

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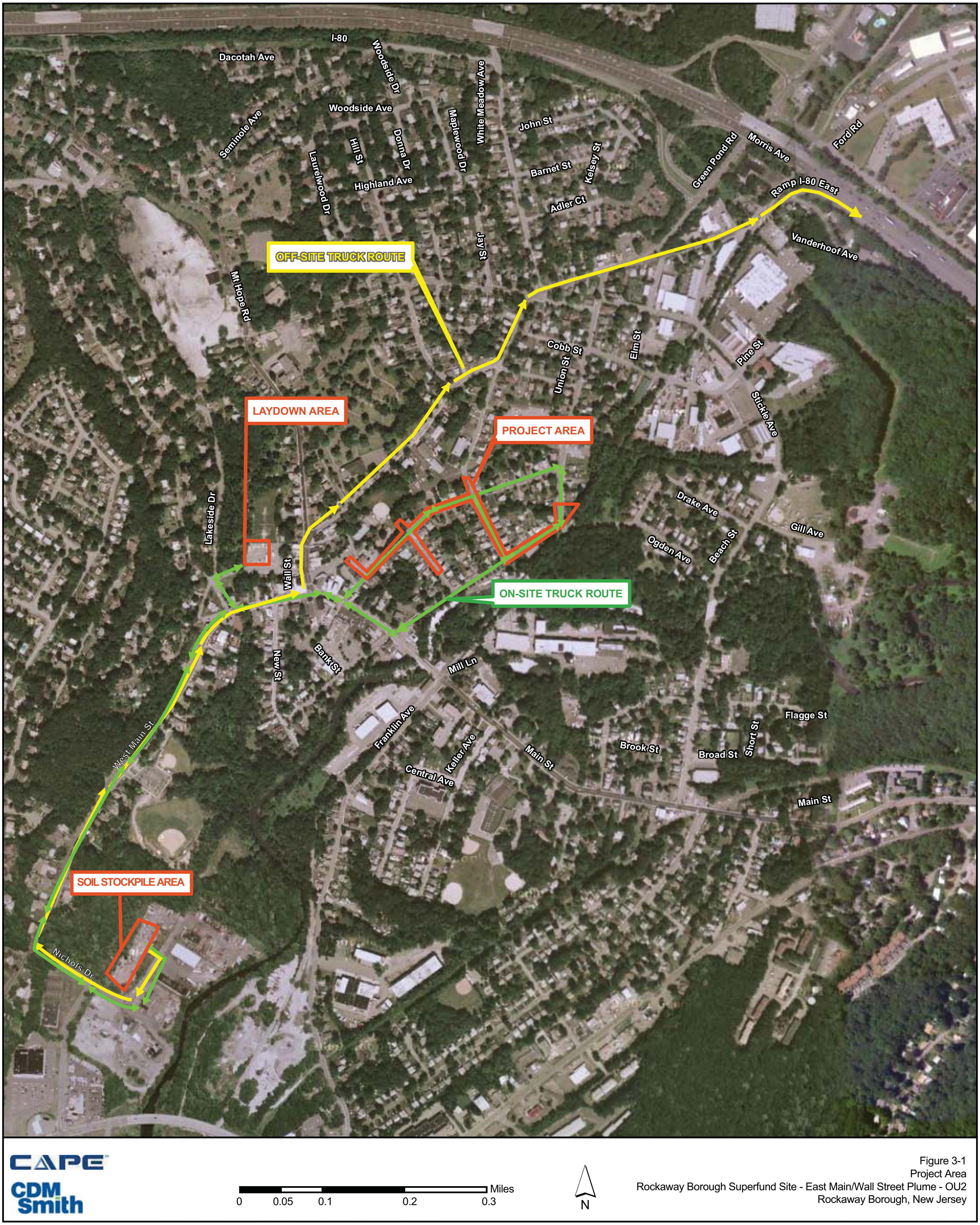

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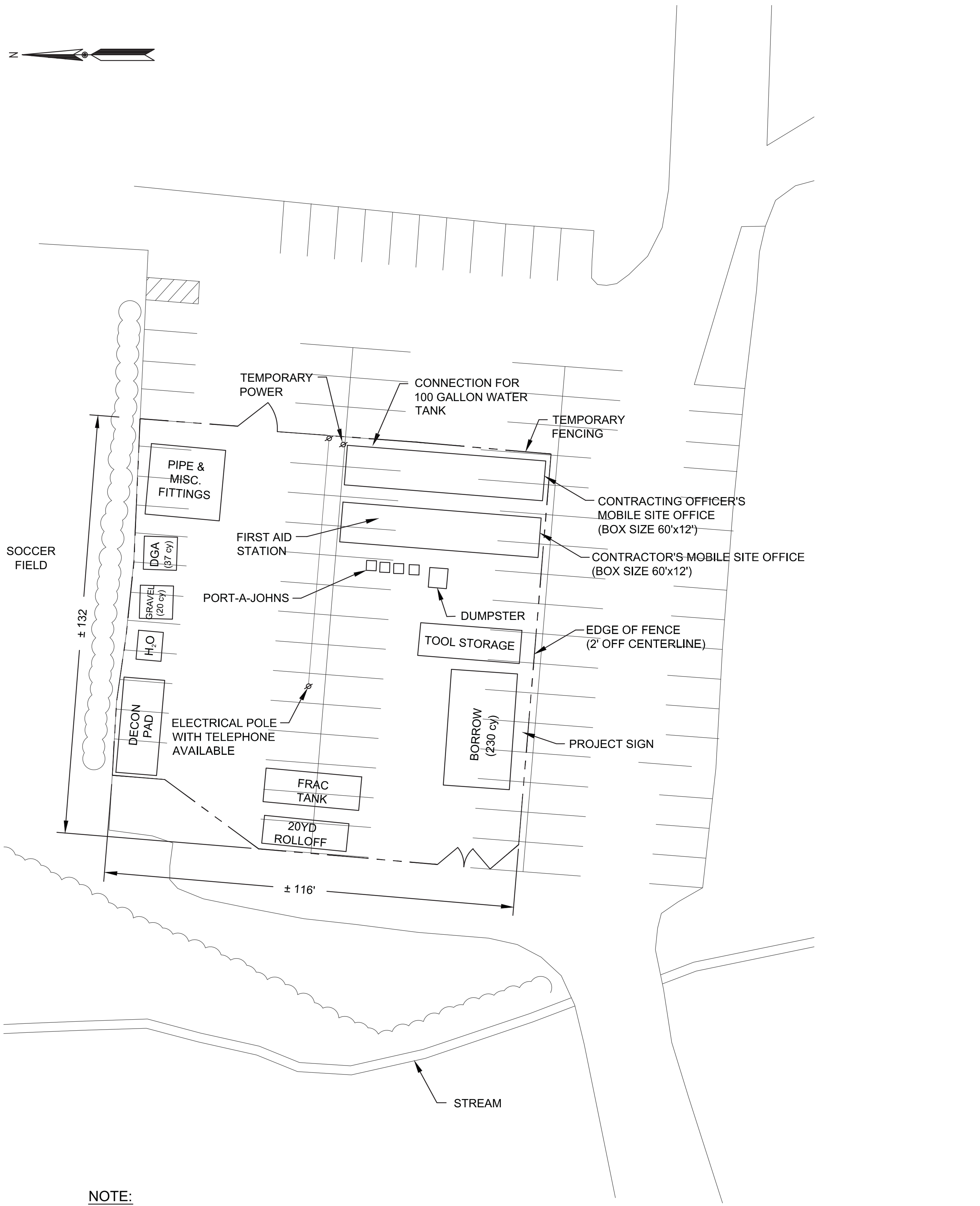
Figure 3-1
Project Area
Rockaway Borough Superfund Site - East Main/Wall Street Plume - OU2
Rockaway Borough, New Jersey



NOTE:
TRAILER COMPOUND DOES NOT INCLUDE PARKING.

GRAPHIC SCALE
40' 20' 0 40'

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Figure 3-2a
Lay-Down Yard
Original Construction Period Layout
Rockaway Borough Superfund Site - East Main/Wall Street Plume - OU 2
Rockaway Borough, New Jersey

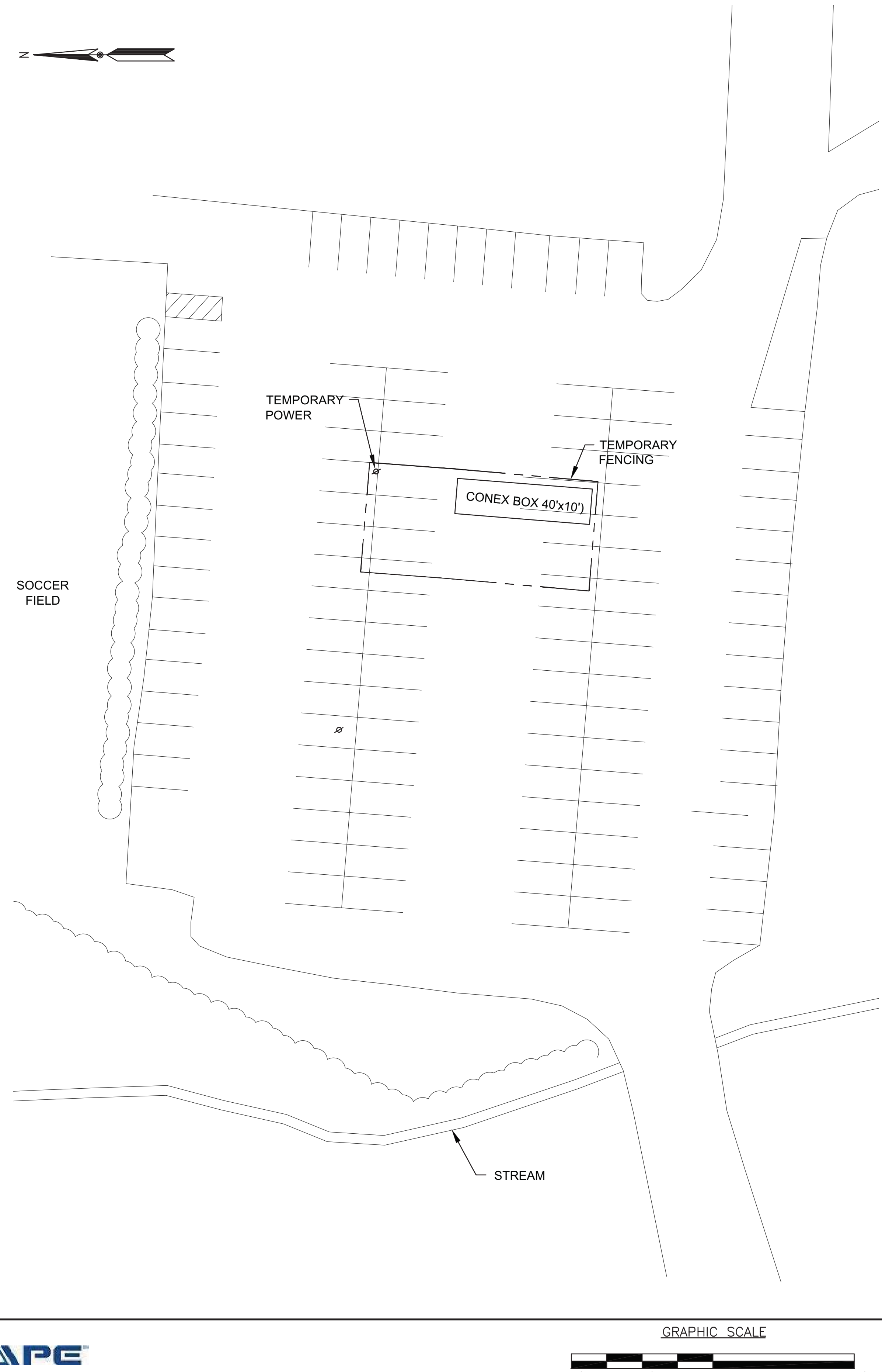

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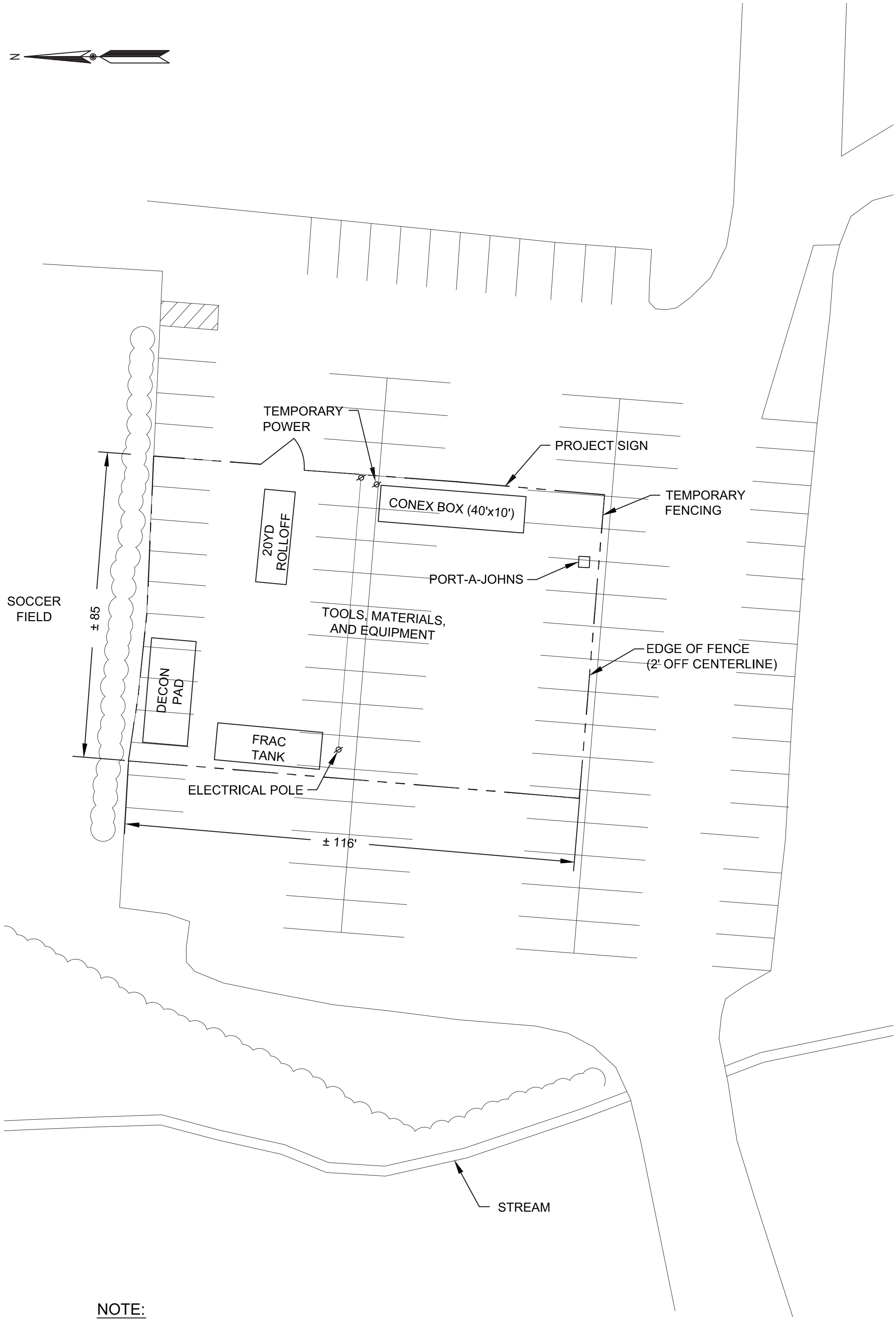
Figure 3-2b
Lay-Down Yard
Shutdown Period Layout
Rockaway Borough Superfund Site - East Main/Wall Street Plume - OU 2
Rockaway Borough, New Jersey



NOTE:
TRAILER COMPOUND DOES NOT INCLUDE PARKING.

CAPE
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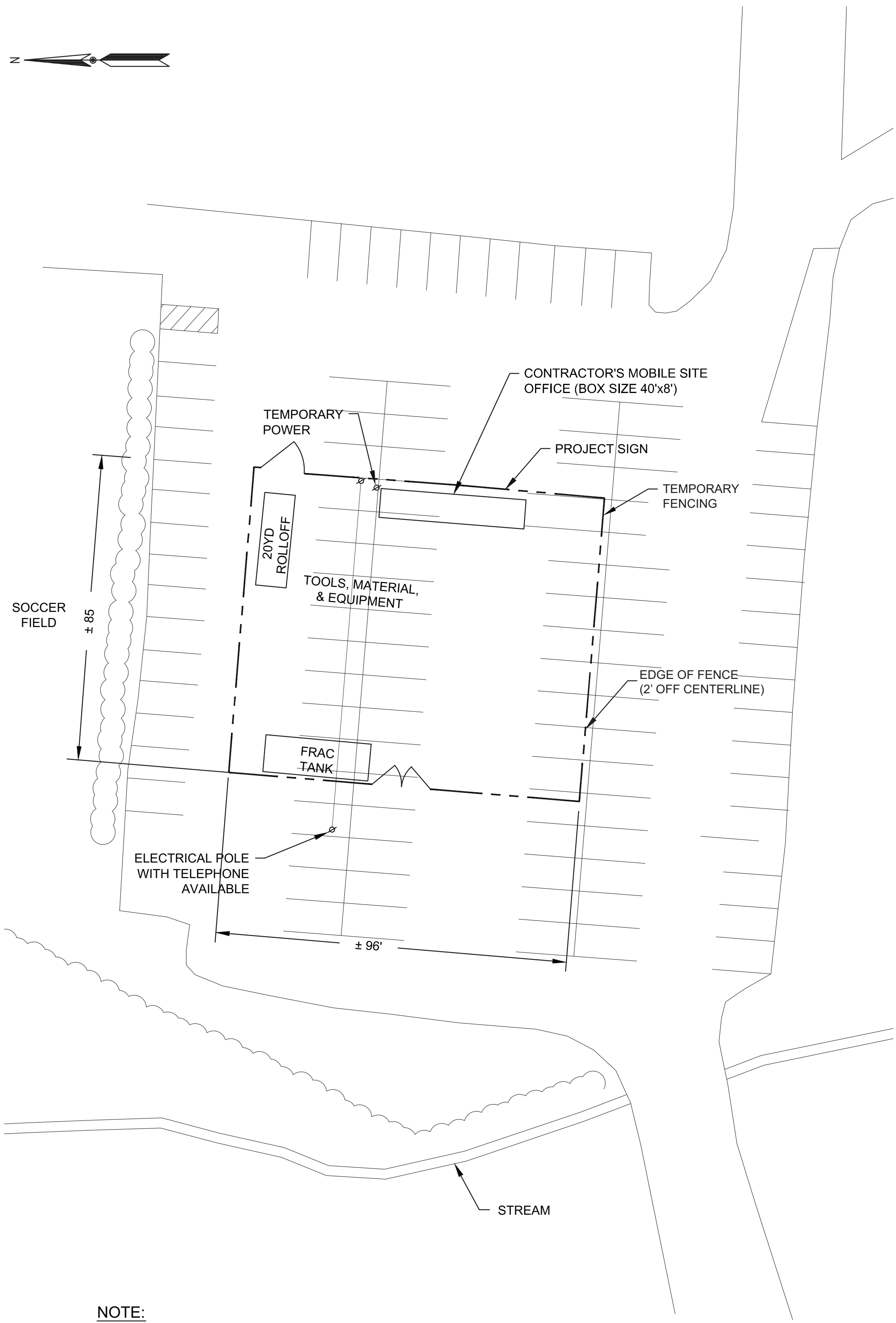
GRAPHIC SCALE
40' 20' 0 40'

Figure 3-2c
Lay-Down Yard
Second Construction Period Layout
Rockaway Borough Superfund Site - East Main/Wall Street Plume - OU 2
Rockaway Borough, New Jersey



NOTE:
TRAILER COMPOUND DOES NOT INCLUDE PARKING.

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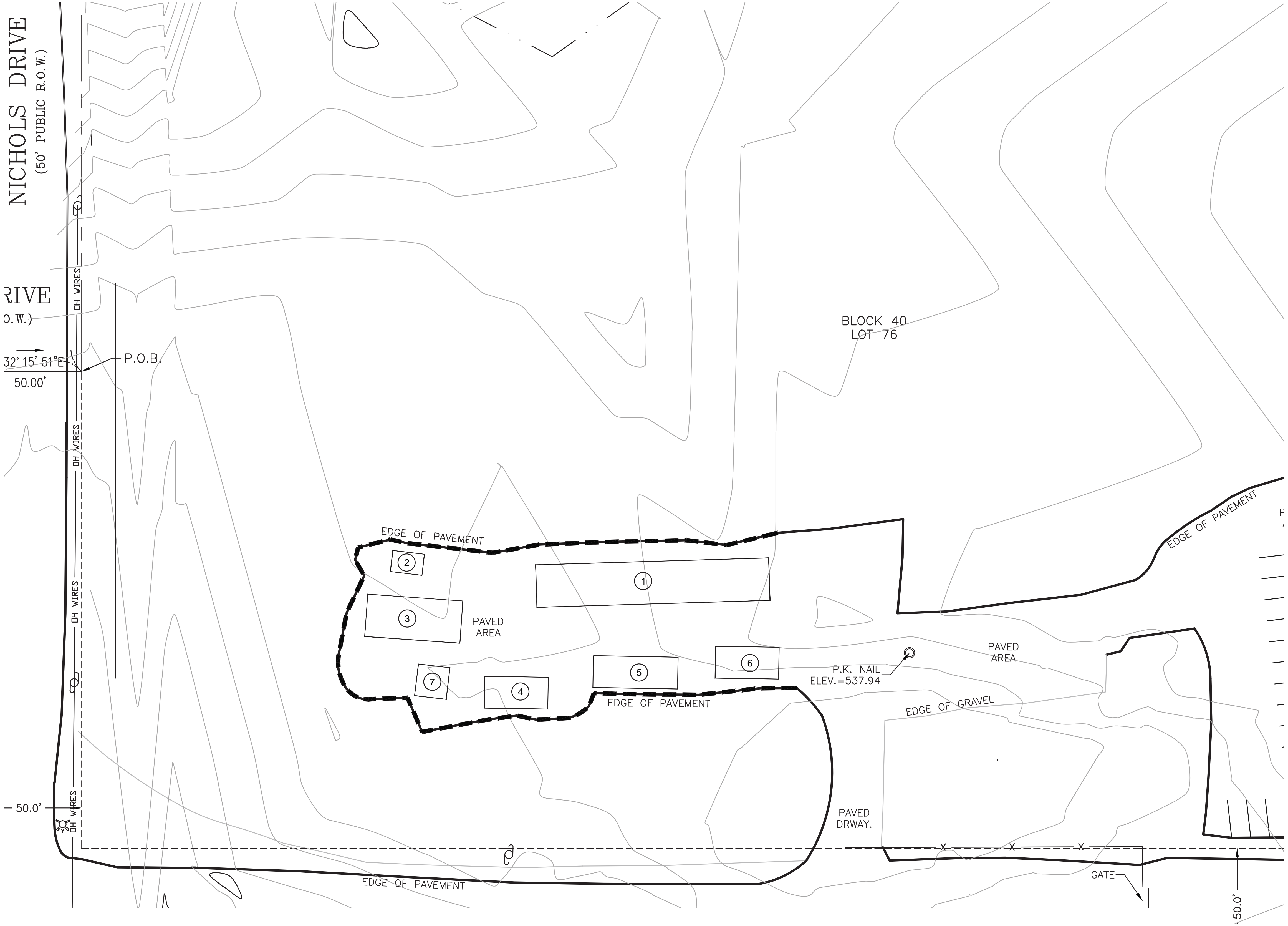
GRAPHIC SCALE
40' 20' 0 40'

Figure 3-2d
Lay-Down Yard
Reduced Layout for Borough Community Activities
Rockaway Borough Superfund Site - East Main/Wall Street Plume - OU 2
Rockaway Borough, New Jersey



1. PRECAST STAGING AREA
2. STRIPPED TOPSOIL STAGING AREA
3. NON-HAZARD SOIL STAGING AREA
4. ASPHALT MILLING STAGING AREA
5. STONE STAGING AREA
6. C & D STAGING AREA
7. STRUCTURAL FILL STAGING AREA

NOTE: ALL REMAINING STRUCTURAL FILL, ASPHALT MILLINGS, STONE, AND PRECAST STRUCTURES WERE TRANSFERRED TO THE BOROUGH OF ROCKAWAY AT THE END OF THE PROJECT.

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GRAPHIC SCALE

50' 25' 0 50'

Figure 3-2e
Lay-Down Yard
Layout of Staging Areas at Gee Property
Rockaway Borough Superfund Site - East Main/Wall Street Plume - OU 2
Rockaway Borough, New Jersey

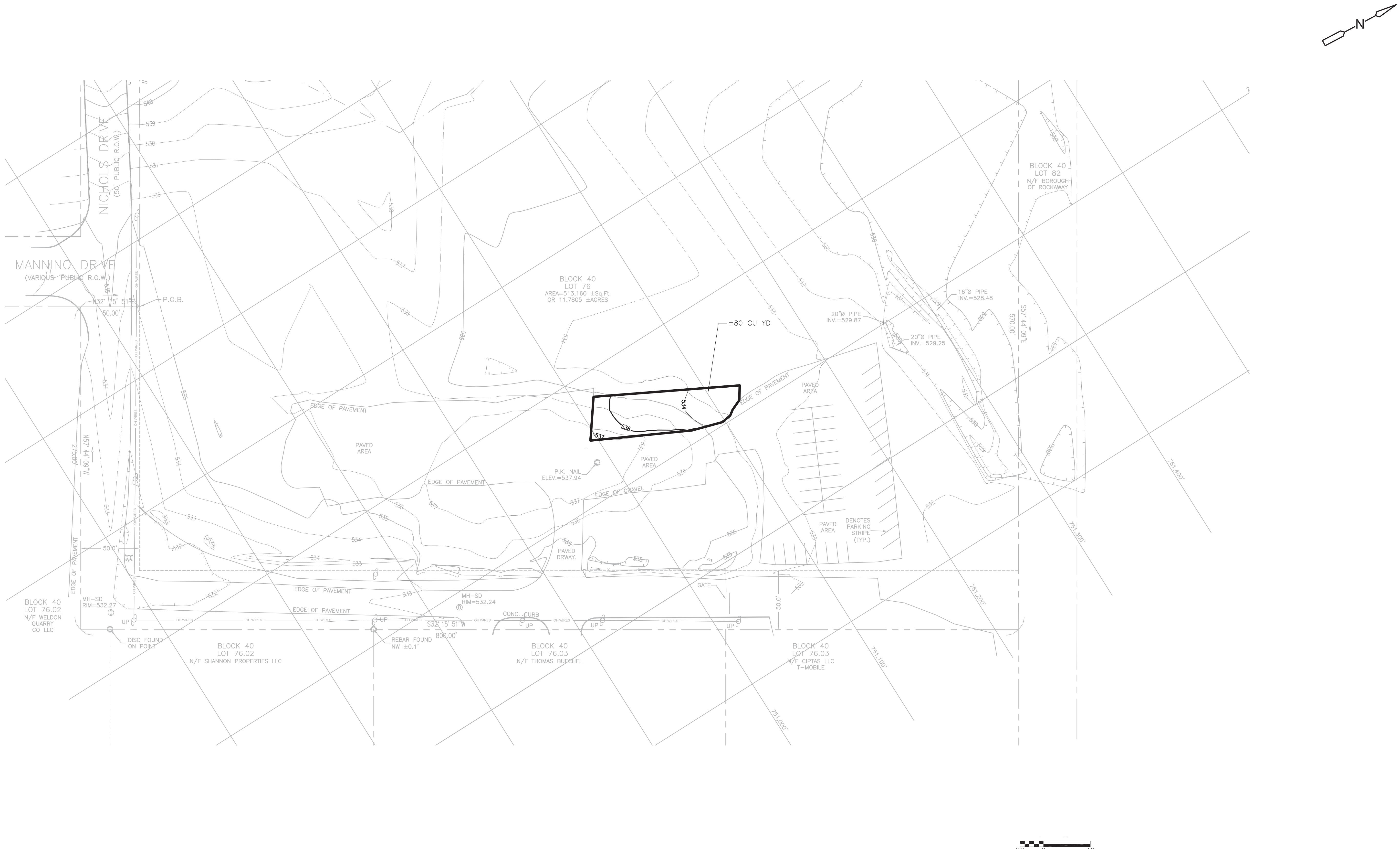

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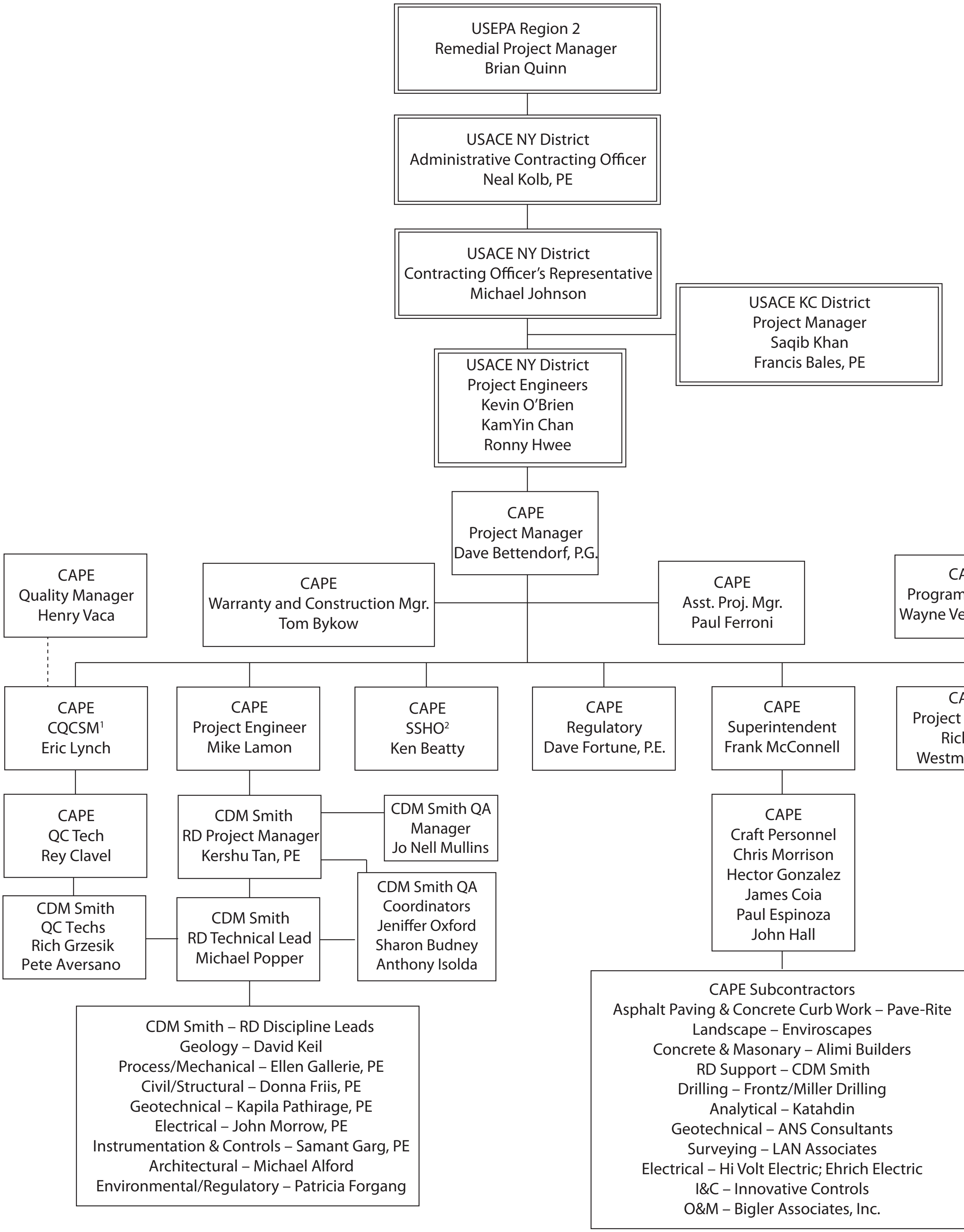
Figure 3-3
Gee Property Site Plan - Proposed Area of Cut
Rockaway Borough Superfund Site - East Main/Wall Street Plume - OU2
Rockaway Borough, New Jersey

Figure 5-1
Organizational Chart
Rockaway Borough Well Field Site Groundwater Treatment System



[1] Previous CAPE CQCSMs include: Glenn Schmidt, Robert Landle, Michael Lamon, Humberto Altamirano, Paul Ferroni, and Josh Caudill
[2] Previous CAPE SSHOs include: Julie Main, Robert Landle, Charles McNeil, Josh Caudill, Cory Jones (Haztec), Eric Lynch, Paul Ferroni, and Thomas Bykow

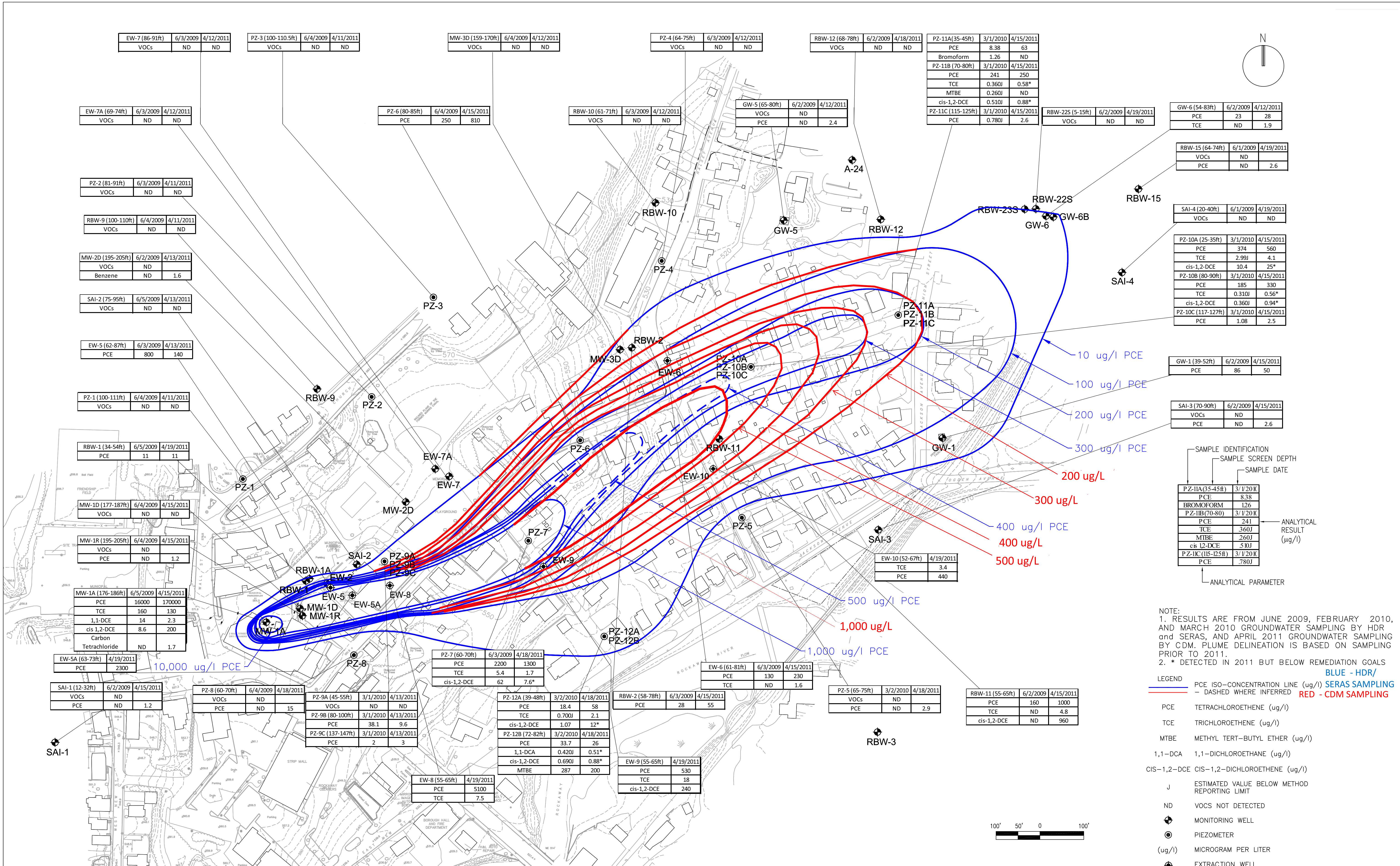


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Figure 6-1
Baseline Groundwater Monitoring Summary
Rockaway Borough Superfund Site - East Main/Wall Street Plume - OU2
Rockaway Borough, New Jersey